BIRLA INSTITUTE OF TECHNOLOGY

PROPOSED STUDENT HOUSING & CAFETERIA

Tender Ref. No.: 26-27/G/PE/00001, Date: 04/05/2026
Last Date of Submission: 05/06/2026, before 3 pm
Mandatory to submit Hard Copies on or before 05/06/2026, 3 pm
Duration of the Work: 15 Months for each block

The address for submission of Quotations and for obtaining further information:

DEPUTY REGISTRAR
BIRLA INSTITUTE OF TECHNOLOGY,
MESRA RANCHI-835 215 (JHARKHAND)
INDIA

TENDER DOCUMENT

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BIT

LIST OF ABBREVIATIONS

AAC	Autoclaved Aerated Concrete Blocks
BIS	Bureau of Indian Standards
BIT	Birla Institute of Technology
EMD	Earnest Money Deposit
etc	et cetera
GCC	General Conditions of Contract
GST	Good and Service Tax
HVAC	Heating, Ventilation, and Air Conditioning
IFS	Indian Financial System Code
IS	Indian Standards
ITT	Instructions to Tenderers
JV	Joint Venture
MEP	Mechanical, Electrical & Plumbing
NIT	Notice Inviting Tender
PAN	Permanent Account Number
PCC	Plain Cement Concrete
RCC	Reinforced Cement Concrete
RTGS	Real-Time Gross Settlement
Sq.ft.	Square Feet
Sq.mt.	Square meter

SECTION: 01
PROJECT BRIEF

BIT

1. Project Brief

Birla Institute of Technology (BIT), Mesra Campus, Ranchi proposes the development of a new student housing complex within its institutional campus to meet the increasing demand for on-campus residential facilities. The project is envisioned as a large-scale, multi-storey residential infrastructure designed to provide safe, comfortable, and efficient accommodation for students, while integrating modern building standards, sustainability principles.

The proposed development is planned on a total land parcel of 3.45 acres and comprises a G+6 storied block consisting of four residential towers, along with a centrally located G+1 storied cafeteria block. The total built-up area of the project is approximately 2,26,220 Sq.ft., encompassing all residential, administrative, services, circulation, and common facilities.

The student housing is designed to accommodate a total of 1016 students through 508 residential units, primarily planned as twin-sharing accommodation. The planning intent focuses on optimal land utilization, efficient vertical circulation, and clear segregation of residential, service, and common functions, while maintaining strong visual and physical connectivity with the campus.

1.1. Project Details

1. **Project Client:** Birla Institute of Technology, Mesra
2. **Project Name:** Proposed Student Housing at BIT
3. **Project Location:** Birla Institute of Technology, Mesra, Jharkhand, 835215.
4. **Plot Area:** 3.5 Acres
5. **Built-up Area:** 2,48,440 Sq.ft.
6. **Site coordinates:** 23.412942 N, 85.440153 E

1.2. Area Statement

The total built-up area is **2,48,440 Sq.ft.**

Table 1: Area Statement

SL NO	DESCRIPTION	TOTAL GROSS AREA (sqm)	DUCTS / CUTOUTS AREA (sqm)	BUILTUP AREA (sqm)	CONSTRUCTION AREA	NO: OF UNITS	REMARKS
1	Ground Floor	761	24	737	845	13	Especially abled room, sick room & visitor room added
2	First Floor	734	24	710	761	18	DB room, washroom layout updated, lounge area and pantry segregated as different areas.
3	Second Floor	766	24	742	800	21	
4	Third Floor	766	24	742	800	18	
5	Fourth Floor	766	55	711	769	17	
6	Fifth Floor	766	55	711	769	18	
7	Sixth Floor	766	24	742	800	22	
8	Terrace Floor	118	0	118	845	0	
TOTAL AREA PER BLOCK (sqm)		**5443**	**230**	**5213**	**6389**	**127**	
TOTAL AREA PER BLOCK (sqft)		**58590**	**2475**	**56110**	**68770**		
					TOTAL NO. OF BLOCKS	**4**	
					NO. OF UNITS IN 4 BLOCKS	**508**	
					TOTAL CAPACITY	**1016**	
					HEIGHT PER FLOOR	**3 m**	
					TOTAL HEIGHT in m (G+6, with 0.6m plinth)	**21.6**	
					BUILT UP AREA FOR TOWER 01 (in sqft)	**56110**	
					TOTAL BUILT UP AREA (4 Blocks) (in sqft)	**224440**	
					AREA FOR CAFETERIA (in sqft)	**24000**	
					AREA BUILT UP AREA (in sqft)	**248440**	

SECTION: 02
NOTICE INVITING TENDER

2. Notice Inviting Tender (NIT)

Date: 04.05.2026

Tenders are invited behalf of the client for the development of BIT MESRA Student Housing in tenders in a single bid system from experienced and eligible contractor for the **"Construction of Student Housing at Birla Institute Technology Mesra Campus on item rate contract basis"** and as per schedule as under:

Table 2: Notice Inviting Tender (NIT)

Tendering Document No.	BIT Student Housing /MESRA/2026 DT : 04.05.2026
Name of the Work	Construction of Student Housing Block 01, Block 02, Block 03 & Block 04, Cafeteria Block for structural and civil works on Item rate contract basis for BIT Mesra, Ranchi.
Brief Scope of Work	Construction of RCC framed structure building including Debris clearance, Excavation, Foundation, Structural Works, Civil Works, external civil works, compound wall, anti-termite treatment, water proofing etc as per scope of work detailed out in the tender document. The scope also includes the coordination with Architect's, plumbing, electrical, firefighting, HVAC consultants and contractors for satisfactory execution of all works/activities in the time bound manner. This project consists of construction of G+6 Floors, as per scope of work the construction should include adopting new & latest technology of construction etc. as per scope of work, detailed Design Basis Report (DBR's), Technical Specifications, Tender Drawings and conditions elaborated in this tender document.
Period of Completion	Overall, **15 (Fifteen) Calendar Months.** As per the phases mentioned in SCC. This includes completion of following building/areas: all external & internal structural works, civil works, anti-termite treatment, water proofing, including plastering. Student Housing Block 01 – 15 Months Student Housing Block 02 – 15 Months Student Housing Block 03 – 15 Months Student Housing Block 04 – 15 Months Cafeteria Block – 12 Months
Earnest Money Deposit (EMD)	Bank Demand Draft of Rs.70,00,000/- in favour of Birla Institute of Technology, Mesra.
Validity of tender open	15 Days from the closing date.
Last date of submission of tender	30 Days from the date of issue of the tender document

BIT

1. Minimum Eligibility Criteria:

The Interested tenderers should meet the following minimum qualification criteria.

A. <u>WORK EXPERIENCE:</u>

A.1. The following shall be the Minimum eligibility criteria for selection of bidders:

a. Legal Valid Entity: The bidders shall necessarily be a legally valid entity either in the form of a limited company or private limited company, registered under the Companies Act, 1956, or JV/consortium, proprietorship, partnership, etc. A proof for supporting the legal validity of bidder shall be submitted.
b. Registration: The bidder should be registered with the Income Tax, GST and also registered under the labour laws - Employees provident fund organization, employees state insurance corporation.
c. Clearance: The bidder should have enclosed 3 years ITR.

A.2. Annual Turnover:

A.2.1. Experience of having successfully completed similar works during the last 7-10 years ending previous day of last date of submission of tenders

a. Three similar works each costing not less than 40% of the estimated cost put to the tender

OR

b. Two similar works each costing not less than 60% of the estimated cost put to the tender

OR

c. One similar works each costing not less than 80% of the estimated cost put to the tender

"Similar works" shall mean construction of Non industrial building project(s) comprising construction of multistoried RCC frames structures having minimum G+5 stores (machine room, mumty shall not be counted as a storey) all works executed under one agreement.

A.3. The tenderers must read the terms and conditions of client. He should be submitting his tender if he considers himself eligible and he is in possession of all the documents required.

B. <u>FINANCIAL STRENGTH:</u>

a. **Average Annual Turnover:** The bidder shall have a **minimum average annual financial turnover of not less than** 50% (Fifty Percent) of the estimated cost of the work put to tender, calculated for the **last three (3)** completed years ending on **31st March 2026.**

b. **Net Worth:** The network of the bidder (company / firm) as on 31st March 2026 shall be positive. Net worth shall be determined on the audited financial statements and shall be **certified by a Charted Accountant.**

c. **Bank Solvency:** The bidder shall submit a self-certified copy of a Bank Solvency Certificate issued by a Nationalized Bank or any Scheduled Bank, for an amount not less than 40% (Forty Percent) of the estimated cost of the project put to tender. The solvency certificate shall be **issued within six (6) months** from the **original last date of submission of the tender.**

d. **Profitability:** The bidder shall not have incurred losses in more than two (2) financial years during the last five (5) consecutive financial years ending on 31st March 2026.

e. **Submission of Financial Documents** The bidders are required to send the following documents along with the tender,

   a. **Summarized Balance sheet** of the last completed financial year (Audited)
   b. **Summarized Profit & Loss Account** for the **last three (3)** financial years (Audited)

2. Set of Contract/Tender Documents:

The following documents will constitute set of tender documents

a) Notice Inviting tender (NIT)
b) Instructions to tenderers
c) General Conditions of Contract (GCC)
d) List of approved make of materials.
e) Architectural layouts
f) Structural layouts
g) Quote sheet for tenderers.

3. The tenderers are required to quote strictly as per terms and conditions, specifications, standards given in the tender documents and not to stipulate any deviations.
4. The tenderers are advised in their own interest to submit their bid documents well in advance from the last date/time of submission of bids so as to avoid last moment/rush while submitting the documents.
5. The tenderers have to fill the unit rate for each item specified without tampering the excel format either by changing the rows or columns, in case of any comments needed to be mentioned in the remarks column only.
6. It is mandatory for the tenderers to share the excel sheet and signed pdf documents via email.
7. Submission of a tender by a tenderer implies that he has read this notice and all other contract documents and has made himself aware of the scope and specifications of the work to be done and of the local conditions and other factors bearing on the execution of the works.
8. The contractors to upload scanned copies of all the documents valid GST registration/ PAN no as stipulated in the tender document.
9. **List of Documents to be scanned, shared via email and also submitted in hard copy with the period of tender submission.**

NOTE: All the documents shared should be in readable, printable and legible form. The document submitted in hard copy.

a. Memorandum of NIT.
b. Unconditional Letter of Acceptance of Tender Conditions (in original)
c. Details of Work Experience certificates
d. Details of Similar works as mentioned in the eligibility criteria.
e. Financial details supporting the financial strength as per eligibility criteria
f. Valid GST registration/PAN NO.

10. Owners/Architects reserve the right to reject any or all tenders without giving any reasons, and to waive any deviation which do not constitute a material modification in the tenders received. They also reserve the right to accept any tender and not only the lowest without giving any reasons. Not more than over tender shall be submitted by a contractor/company/firm. Architect's/Client has right to choose the contractor and not mandatory.
11. If the tenderers shall submit the tender which satisfies each and every condition laid down in this notice and tender documents. Failing which, the tender shall be liable to be rejected.

3. Memorandum

Table 3: Memorandum

SR.NO.	DESCRIPTION	CL.NO OF NIT/ITT/ GCC	VALUE/DESCRIPTION
1	Name of the work		Construction of BIT Student Housing
2	Client/Owner		Birla Institute of Technology
3	Type of tender		Item Rate Contract
4	Earnest Money Deposit	NIT	**Rs.70,00,000/-** (Rupees Seventy Lakhs Only).
5	Time allowed for completion of work	NIT	Overall, **15 (Fifteen) Calendar Months.** This includes completion of following activities: all external & internal structural works, civil works, anti-termite treatment, water proofing, including plastering.
6	Mobilization Advance	GCC	10% of the contract value against bank guarantee
7	Interest Rate of Mobilization Advance	GCC	Not Applicable
8	Performance Guarantee	GCC	3% (Five Percent Only) of contract value within 30 days from the issue of Letter of Award
9	Retention Amount	GCC	7% of contract value from each RA Bill
10	Mobilization		The date of start of contract shall be reckoned from **15 days after the date of issue of letter of Award/handing over the site/ Agreement whichever is later.**
11	Defects Liability Period	GCC	12 Months from the date of issuance of final completion certificate

BIT

SR.NO.	DESCRIPTION	CL.NO OF NIT/ITT/ GCC	VALUE/DESCRIPTION
12	Installment of retention amount	GCC	50% at virtual completion 50% after Defects Liability Period.
13	GST, VAT, Excise, Octroi on all construction materials and any Levies	GCC	To be borne by the contractor as applicable
14	GST on client supplied	GCC	It will be paid by the client
15	Insurance covered by the contractor	GCC	A. Workmen's compensation B. Contractors all risk policy C. Third Party D. Other relevant policy for the project.
17	Electricity	GCC	Supply to be provided by client at single point, installation, permissions, maintenance to be taken care by contractor. The cost of electricity will be borne by the contractor on actual basis (through meter).
18	Water	GCC	To be supplied at single point, if available, free of cost, regular maintenance to be taken care by contractor.
19	Police Management/Safety Management	GCC	Coordination with local police, safety, security, traffic management, emergency response plans other protocols to be taken care by contractor
20	Security on site	GCC	Contractor to hire full time security for day and night and ensure the maintenance of logbooks
21	Safety	GCC	Contractor to ensure that the labour is provided with safety shoes, helmet and apron etc. all the time.
22	Labour Tents	GCC	Vacant space will be provided by BIT and it will be the responsibility of the contractor to make arrangement for labour huts etc.
23	Failure of completion of particular item	GCC	In case of failure to complete the project or any specific item, the contractor shall be compensated the cost of work equal to 20% more than quoted rate or actual, whichever is higher.

4. Instruction to tenderers

1. **Contractors to read this carefully**
   a) The rate of items in the schedule **of items/quantities** must be given in words and figures. Amount of each item must also be entered in the column and the grand total of the amount must be struck out by the tenderers.
   b) If the tender is taken in favor of the company, a power of attorney in favor of the person who may have signed the tender of the company must accompany the tender.
   c) The tender document should be signed by the contractor.
   d) All corrections, erasures and overwriting should be initiated by the contractor.
2. Discrepancies and adjustments of errors:
   a. In the event of a discrepancy between description in works and figures quoted by a tenderer in the rates column, the description in words shall prevail.
   b. In the event of an error occurring in the amount column of the schedule of items/quantities showing items of work, as a result of wrong multiplication of the unit rate and quantity, the unit rate shall be regarded as firm and multiplication shall be amended on the basis of the rate.
   c. All errors in totaling in the 'amount' column in carrying forward total shall be corrected.
   d. Any rounding of amount against 'items' or in 'totals' shall be ignored.

The tendered sum so altered shall for the purpose of the tender be substituted for the sum originally tendered and considered for acceptance.

3. Before quoting the rates, every tenderer is **expected to inspect the site** of the proposed work and to have satisfied himself as to the nature of all works, all existing roads, water-way and other means of communication and access to and from the site and work and the building that may be required for temporary purposes in connection with the construction, completion and maintenance of the works and must make his own inquiries as to work, yard sites and depot and dumps and as to acquisition of such additional sites and areas as may be necessary for temporary purpose for constructing, completing and maintaining the works. He must ascertain the availability of space for storage of construction materials, water supply, electricity, means of access to the work, nature of work and acquaint himself with all local conditions. A tenderer shall be deemed to have full knowledge of all the relevant documents, samples, etc. whether he inspects them or not before submitting the tender.
4. Submission of a tender by a tenderer implies that he has read this notice and all other contract documents and has made himself aware of the scope and specification of the work to be done and of local conditions and other factors bearing on the execution of the works.
5. Person's tendering is informed that no erasures or alterations by them in the text of the document sent herewith shall be allowed and any such erasures or alterations shall be disregarded. If there is any error in writing, no overwriting should be done, the wrong word or figure should be struck out and the correct one written above or neat it in an unambiguous way. Each correction should be initiated.
6. The successful tenderer shall take out insurance policies for all risk and for third party for the value according to the contract cost and instructions shared by clients/ Engineer In-charge.
7. This agreement is subject to Indian Law. Place of performance and Jurisdiction is the registered office of the principal in Bangalore, Karnataka.

8. Changes and supplements as well as termination notices need to be made in writing.
9. If the contractor/tenderer is a partnership or a consortium, this agreement must be signed by all the partner or consortium members.
10. If one or several provisions of this agreement turn out to be invalid, the remainder of this agreement shall remain valid and binding. In such a case, the parties will strive to come to an agreement in accordance with their original intentions.
11. It is agreed that any dispute or difference arising between the parties with regard to the terms and conditions, any action taken by the principal architect/client in accordance to the terms and conditions or interpretation thereof shall not be subject to arbitration. Any dispute between the parties shall be subject to commercial courts of Bangalore only.

_____
Tenderer/Contractor

CONTRACTOR'S GENERAL INFORMATION

Tenderer has to fill this form and submit along with the tender document to Client

Table 4: Contractors General Information

SR.NO.	DESCRIPTION	DETAILS
1	Name of Applicant/Company	
2	Address of correspondence	
3	Official E-mail for communication	
4	Contact Person: Telephone Nos: Mobile No:	
5	Type of Organization: a. An Individual b. A proprietary Firm c. Partnership Firm (Attach copy of partnership) d. Limited Company (Attach copy of article of association)	
6	Place and Year of Incorporation	
7	Name of Directors/Partners in the organization	
8	Name and Designation of the person who is authorized to deal with	
9	Bank Details: Name of the bank, Address of bank branch, Account No, RTGS, IFSC Code	

Signature of Tenderer with Seal

GST REGISTRATION DETAILS OF CONTRACTOR

Table 5: GST Details of Contractor

Name	
Address (As per registration with GST)	
City	
Postal Code	
State (Complete State Name)	
Permanent Account Number (PAN)	
GSTIN ID	
Type of Business (As per registration with GST)	
Service Accounting Code/HSN Code:	
Contact Person	
Phone Number and Mobile Number	
Email ID	

SECTION: 03
GENERAL CONDITIONS OF CONTRACT

5. General Conditions of Contract

SUB-SECTION- I

5.1. DEFINITION OF TERMS

All the headings of the clauses, in these General Conditions of Contract or otherwise in any Contract Document, are intended solely for the purpose of giving a broad indication of the contents of the clause and not a summary thereof.

5.1.1. Definitions

In the Contract Documents, as herein defined, where the context so admits, the following words and expressions shall have the following meanings:

(a) "**Agreed Variation**" shall mean the statement of agreed variation annexed to the Contract and / or Purchase Order.

(b) "**Alteration Order**" means an order given in writing by the Owner to effect additions to or deletions from and alteration in the Work.

(c) "**Applicable Laws**" means all laws, brought into force and effect by Government of India or any State Government including rules, regulations, bye-laws, ordinances and notifications made thereunder, and judgments, decrees, injunctions, writs and orders of any court of record, applicable to this Contract including the exercise, performance and discharge of the respective rights and obligations of the Parties hereunder, as amended, re-enacted or consolidated from time to time.

(d) "**Anti-Corruption Laws**" means, in relation to a Person, all Applicable Laws relating to anti-bribery, anti-corruption, anti-terrorism and anti-money laundering applicable to such Person including, where applicable but without limitation, the Prevention of Corruption Act 1988, the Prohibition of Benami Property Transactions Act 1988, Prevention of Money Laundering Act 2002, the Unlawful Activities (Prevention) Act 1967 and the Black Money (Undisclosed Foreign Income and Assets), Imposition of Tax Act 2015, U.K. Bribery Act, 2010 and the U.S. Foreign Corrupt Practices Act, 1977.

(e) "**Approved**" shall mean approved in writing including subsequent written confirmation of previous verbal approval and "**Approval**" means approved in writing including as aforesaid. In no case "**Approval**" shall be interpreted as acceptance by any conduct of the Owner.

(f) "**Architect**" means such Person appointed by the Owner who prepares the Drawings and Specifications.

(g) "**BOQ**" or "**Bills of Quantities**" means quantities of materials and labour proposed to be utilized by the Contractor towards execution of the Works, as forming part of the Tender and the Contract Documents.

(h) "**Completion Time**" means the period of time (number of calendar days or months or years) shown in the Tender, allowed for completing the execution of the Works and passing of the tests on completion of the Works as set forth in the Contract.

(i) "**Contractor's Personnel**" shall mean all such Persons employed, contracted or engaged in any manner whatsoever by the Contractor towards performing any part of the Works under this Contract and shall include the Sub-Contractors (and the Persons employed or engaged by such Sub-Contractor), Site Manager and the Project Manager.

(j) "**Construction Manager**" means such Person appointed by the Owner who is responsible for: (a) overseeing and directing Works from conception to completion; (b) reviewing the Works in detail, schedule deliverables, and estimate costs and budget; and (c) is responsible for compliance with building and safety regulations.

(k) "**Consultant**" means such Person appointed by the Owner who shall provide the details for the design of the Project.

(l) "**Contract**" shall mean the contract effected by the Contractor's Tender and the Owner's acceptance thereof comprising (in addition to the Tender and acceptance) the BOQ, Schedule of Rates, schedules of particulars (if any), Specifications and Drawings, the GCC, SCC and any special or particular conditions contained in or attached to any of the foregoing documents, any alteration agreed in writing between the Parties before the formal acceptance of the Tender, all these documents taken together, shall be deemed to form one contract and shall be complementary to one another.

(m) "**Contract Documents**" shall have the meaning given to such term in Clause 1 of Section III of this GCC and shall include all instructions, issued from time to time by the Owner and / or the Engineer-In-Charge, which shall be deemed to form one contract and shall be complimentary to one another.

(n) "**Contractor**" means the person or the persons, firm or company whose tender has been accepted by the Owner and includes the Contractor's legal representative, his successor and permitted assigns.

(o) "**Contractor's Representative**" shall have the meaning given to such term in Clause 12.1 of Section III.

(p) "**Contract Period**" means the period on from the Effective Date (as defined under the Special Conditions of Contract) and until the expiry or early

termination of the Contract, in accordance with the provisions contained herein and the Special Conditions of Contract.

(q) "**Contract Price**" means the price payable by the Owner to the Contractor for the construction of Works under this Contract and as specified in the Purchase Order to be issued by Owner to the Contractor in accordance with the terms of this Contract.

(r) "**Defects Liability Period**" in relation to the Work means the specified period from the date of completion of any Work as stipulated in the Contract, during which the Contractor stands responsible for rectifying all defects that may appear in the Work(s).

(s) "**Drawings**" shall include the drawings mentioned in the Contract Document, any modification of such drawings, approved in writing by the Owner and such other drawings as may be approved from time to time, calculations, maps, plans and tracings or prints, samples, patterns, models, operation and maintenance manuals and other technical information submitted by the Contractor and approved by the Owner.

(t) "**Engineering Consultant**" means such Person [appointed by the Owner] who shall provide all technical design details in relation to the Drawings, documentations and Specifications for execution of the Works.

(u) "**Engineer In-charge**" or "**EIC**" shall mean the persons designated as such by the Owner and shall include those who are expressly authorised by it to act for and on its behalf for the implementation of the Contract.

(v) "**Final Completion Certificate**" shall mean the certificate to be issued by the Engineer-In-Charge when the Works have been completed in all respect (including attending of all check-list points) to the satisfaction of the Engineer-In-Charge and the Owner.

(w) "**Final Certificate**" in relation to the Work shall mean the certificate regarding the satisfactory compliance of the various provisions of the Contract by the Contractor, issued by the Engineer-In-Charge after the Defects Liability Period is over.

(x) "**Financing Entity**" means such entities from which Owner has availed any form of loans or debt facilities in relation to the Project.

(y) "**Force Majeure**" shall mean the occurrence in India, of any of the following events: (i) industry-wide or state-wide riots or civil commotion (in so far as both these are uninsurable) which continue for a consecutive period of thirty (30) days or an aggregate period of 90 (ninety) days in a financial year, other than involving the Contractor's or Sub-Contractor's employees, labour or staff; (ii) war (whether declared or not), invasion, acts of hostilities of foreign

enemies, civil war, rebellion, insurrection, military or usurped power; (iii) any act of Governmental Authorities; or (iv) Act of God, such as lightening, unprecedented floods, tornado, and damage from aircraft, the occurrence of which affects the performance, by the Party claiming the benefit of Force Majeure (the "**Affected Party**"), of its obligations under the Contract and which act or event (a) is beyond the reasonable control of the Affected Party, (b) could not have been reasonably foreseen at the time of execution of the Contract; (c) is not usual during the time of year when it occurred; (d) has not been known to have occurred repetitively in the past, (e) the Affected Party could not have prevented or overcome by exercise of due diligence and following Good Industry Practice, and (f) has material adverse effect on the Affected Party. Provided that a mere increase of costs or imposition of any economic hardship on a Party shall not be construed as a Force Majeure.

(z) "**GCC**" means the General Conditions of Contract as set out in this **Schedule [·]**;

(aa) **"Good Industry Practice"** shall mean the exercise of such degree of skill, diligence and prudence as would reasonably and ordinarily be expected from a skilled and experienced Person engaged in the same type of undertaking as the Contractor and applying the standards generally adopted by contractors in the construction and development of facilities adhering to the practices generally followed by such Persons.

(bb) **"Governmental Authority"** means any (a) governmental or quasi-governmental authority of any nature (including, without limitation, any governmental agency, branch, department or other entity and any court or other tribunal) including a national, regional, state, district, city, town, village, or other governmental authority having jurisdiction; or (b) body exercising, or entitled to exercise, any administrative, executive, judicial, legislative, regulatory or taxing authority or power of any nature.

(cc) "**IS**" means Indian Standards;

(dd) **"Measurement Books**" means books maintained during the period of the Project to record all measurements qualifying for payment. The Contractor shall maintain Measurement Books of all work done by them. The Contractor shall get the Measurement Books verified by the Project Manager / quantity surveyor periodically. It shall be responsibility of the Contractor to get all the works verified as per the Measurement Books, before they get concealed. If the Contractor fails to get the measurements of underlying items verified in time, then he shall remove the overlying or concealing items and get the underlying or concealed items verified and make the work good at no extra cost to the Owner. All Measurement Books shall be hard bound with pages numbered. The Owner / Project Manager and the Contractor shall verify the condition of the Measurement Book before implementation. No tearing of pages or overwriting shall be permitted in the Measurement Books. Only neat

cutting of mistakes with joint signatures of Contractor's Representative and the Project Manager / quantity surveyor shall be permitted.

(ee) "**Order and Instructions**" shall mean any written order or instruction given by the Owner within the scope of their respective powers in terms of the Contract.

(ff) "**Owner**" shall mean the company / organisation which intends to get Works done through the Contract as mentioned in tender instruction or, their successors and assigns from time to time.

(gg) "**Person**" shall mean any natural person, firm, company, joint venture, partnership, association or other entity (whether or not having separate legal personality);

(hh) "**Programme Schedule**" shall mean the [chart] reflecting the progress schedule for the Works, as prepared by the Contractor and approved by the Owner, setting out all relevant details in relation to the execution of the Works, as may be requested by the Owner, including sequence and milestone dates for each of the Works to be executed at Site.

(ii) **"Project"** shall mean development of the [·] at the Site as per the Specifications and terms laid down in the Contract and within the Time Schedule.

(jj) **"Project Manager**" means the company appointed by the Owner to render project management consultancy services for the Project.

(kk) "**Purchase Order**" shall have the meaning given to such term in Clause 2A of Section III of this GCC;

(ll) "**Records and Audits**" shall mean all the documents, measurement books, details and all necessary documents pertaining to the contract as specified by the EIC / Owner. The Contractor shall maintain / keep all the books and records as specified by, and to the complete satisfaction of, the Owner, in such a manner, so as to enable the Owner, to carry out effective financial control.

(mm) "**Running Account Bill**" **"R.A. Bill"** means the Bill(s) submitted by the Contractor on monthly basis for the Work(s) carried out during the immediately preceding month.

(nn) "**SCC**" means the Special Conditions of Contract set out in **Schedule [·]**.

(oo) "**Schedule of Rates**" means the schedule of rates with respect to the material and labour being utilized in the Works, annexed to the [Contract and Purchase Order] and shall include all remunerations payable to the Contractor for any work determined in accordance with the conditions herein.

(pp) "**Scope of Work**" shall mean the totality of the Work envisaged in the Contract and shall include all plants, equipment, appliances, labours, materials of whatsoever in nature for the use, in or for execution, completion, operation or maintenance of the Work.

(qq) "**Site**" means the area on which the permanent Works are to be executed or carried out and any other places provided by the Owner for the purpose of the Contract.

(rr) "**Site Facilities**" means the facilities to be provided by the Contractor and Owner, as may be applicable, as set out in Part II of this General Conditions of Contract.

(ss) "**Site Manager**" means the project management consultant appointed by the Owner who shall be responsible for supervising construction activities over all for the Project.

(tt) "**Specifications**" shall mean the specifications annexed to or issued with these conditions and includes Indian or other approved standard specifications where required by the Specification and where such specification is not available, the specification approved by the Architect and the Engineer-In–Charge.

(uu) "**Sub-Contractor**" means any person or firm or Company (other than the Contractor) to whom any part of the Work has been entrusted by the Contractor, with the written consent of the Engineer-In-Charge, and the legal representatives, successors and permitted assigns of such person, firm or company.

(vv) "**Supplier & Vendor**" shall mean the Contractor.

(ww) "**Time Schedule**" shall have the meaning given to such term in Clause 6.1 of Section III.

(xx) "**Virtual Completion Certificate**" means the certificate issued by the Engineer-In Charge upon the Contractor achieving Virtual Completion in accordance with Clause 32 of Section IV.

(yy) "**Work**" shall mean the permanent and the temporary works, or either of them as appropriate, to be executed in accordance with the Contract or part there of as the case may be, and shall include all extra, additional, altered or substituted Works as required for the purpose of the Contract.

(zz) "**Taxes**" means means all national and local direct and indirect tax, including any tax on income, capital stock, profits, gross receipts, sales, use, value added, capital gains, transfer, profits, registration, stamp duty, premium, excise, customs duties, octroi, severance, environmental, real property, movable

property, ad valorem, occupancy, license, occupation, withholding tax, stamp duty, fee, minimum alternate tax, dividend distribution tax, municipal taxes, service tax, goods and services tax, assessment or other governmental charge or other taxes, assessments or levies, fees, assessments or charges of any kind whatsoever, including any surcharge or cess thereon, together with any interest and any penalties, additions to tax or additional amount with respect thereto;

(aaa) "**Tende**" means the Contractor's price offer to the Owner for the execution and completion of the works and the remedying of any defects therein in accordance with the provisions of the Contract.

(bbb) "**Tenderer**" means the firm / company who submitted the filled up Tender for the purpose of executing the work under reference.

(ccc) "**Tests on Completion**" means the tests specified in the Contract or otherwise agreed by the Owner and the Contractor which are to be carried out by the Contractor before the Works or any section or part thereof are taken over by the Owner. The costs for all such tests are deemed to be included in the quoted rates and are to be borne by the Contractor.

(ddd) "**Third Party Contractor**" shall have the meaning given to such term in Clause 14.8 of Section III.

(eee) "**Total Contract Value**" shall mean the total value of the Contract as specified in the Special Conditions of Contact including all the addition to or deletion from and alterations for any particular Work.

(fff) "**Variation**" shall have the meaning given to such term in Clause 5.1 of Section III.

(ggg) "**Virtual Completion**" shall mean that the Works have been, completed in every respect in conformity with the Contract Documents, Specifications and Drawings, and are ready and fit for occupation / commissioning and accepted in writing by the EIC / authorised representative of the Owner.

(hhh) "**Working Day**" means all days of the week other than Saturdays and Sundays, on which banks in [Bangalore, India] are open for business.

5.1.2. Interpretation

In the General Conditions of Contract, unless the context otherwise requires:

(a) The words importing the singular shall mean the plural and vice versa; and words importing the masculine shall include the feminine and neuter and vice-versa.

(b) Where any word or expression is given a defined meaning, any other grammatical form of that word or expression shall have the corresponding meaning, where the context requires.

(c) Any word or expression used in the Contract shall, unless defined or construed in the Contract, bear its ordinary English meaning.

(d) "" shall refer to clauses of the GCC. Save and except the foregoing, “” shall refer, respectively to Annexures to the GCC. The Annexures to the GCC shall form an integral part of the GCC and will be in full force and effect as though they were expressly set out in the body of the Contract.

(e) The headings and sub-headings under the Contract (and references to them) are included for convenience only and shall not be taken into account in interpreting the Contract.

(f) The references to the word "include" or "including" or to the phrase "in particular", shall be construed without limitation.

(g) The references to any contract, agreement, indenture, deed or other instrument shall be construed as a reference to such contract, agreement, indenture deed, or other instrument as the same may, from time to time, be amended, varied, supplemented or novated.

(h) The interpretation of a provision of the Contract shall not be construed adversely against a Party solely because that Party drafted the provision.

(i) Time is of the essence in the performance of the Contractor’s obligations under the Contract. If any time period specified herein is extended, such extended time period shall also be of the essence.

(j) All notices shall be in writing (where the expression "writing" or in "written" shall include communications by e-mail, fax, telegram, and letter) and the words "notify", "endorse", "approve", "permit", "certify" or "determine" shall be construed accordingly. Where any notice, consent or approval is to be given by either of the Parties, the notice, consent or approval shall be given on their behalf only by any Authorised Persons as identified in the Contract.

(k) Any reference to a statutory provision shall include such provision as is from time to time modified, re-enacted, or consolidated, so far as such modification, re-enactment or consolidation applies or is capable of applying to any transaction entered into hereunder.

(l) Any reference to any period of time shall mean a reference to that according to Indian Standard Time.

(m) Any reference to a month shall mean a reference to a calendar month.

(n) Unless otherwise specified, any reference to a period commencing "from" a specified day or date and "till" or "until" a specific day or date shall include both such days or dates.

(o) When the words "approved", "subject to approval", "satisfactory", "equal to", "proper", "requested", "as directed", "where directed", "when directed", "determined by", "accepted", "permitted", or words and phrases of like importance are used, the approval, judgment, direction, etc. is understood to be a function of the Owner.

(p) Period of "**Years**", "**Months**", "**Weeks**" and "**Days**": "**Year**" means 365 (three hundred sixty five) consecutive calendar days, "month" means the first calendar day of a month to the last calendar day of such month, "week" means 7 (seven) consecutive calendar days and a "day" means a single calendar day, irrespective of numbers of days and hours worked in relevant period.

(q) In case of ambiguities or discrepancies within the Contract Documents, the following shall apply:

(i) between two clauses of this GCC, the provisions of the specific clause relevant to the issue under consideration shall prevail over those in the other clause.

(ii) between two Annexures of this GCC, the Annexure relevant to the issue under consideration shall prevail;

(iii) between any value written in numerals and that in words, the latter shall prevail;

(iv) between the Agreement and the Purchase Orders, the Agreement shall prevail over the Purchase Orders; and

(v) between the GCC and the SCC, the SCC shall prevail over the GCC.

SUB-SECTION- II

5.2. GENERAL INFORMATION

5.2.1. SCOPE OF WORK

The Scope of Work is defined in the invitation of tender and also in Special Conditions of Contract. The Contractor shall provide all items necessary for the execution and maintenance of the work, including all materials, equipment and labour, till Final Certificate is issued and all other obligations of the Contractor under the Contract (including any obligations that may arise during the Defects Liability Period) are duly complied with, unless otherwise specifically mentioned. All materials and equipment that go with the work shall be approved in writing by Engineer-In-Charge prior to the procurement and use.

5.2.2. WATER

(a) Construction Water

Unless otherwise specified in the SCC, Contractor shall, at its own expense, arrange for the supply of water, as may be required, for the execution and maintenance of work under the Contract without any cost to the Owner and make necessary arrangements at their own cost for storage, installation, operation, maintenances and dismantling of the distribution system.

(b) Drinking Water

Unless otherwise specified, Contractor shall, at its own expense, make adequate arrangements for supply of water for drinking for its staff and labour (including Sub-Contractors) and make necessary arrangements for storage, installation, operation, maintenances and dismantling of the distribution system.

5.2.3. POWER SUPPLY

Unless otherwise specified, Contractor shall, at its own expense, make adequate arrangements for supply of power, as may be required for the execution and maintenance of Work under the Contract. Further distribution and removal on completion of the Project shall be done by Contractor at his cost. If the power is provided by the Owner, the cost of consumption shall be recovered by the Owner on actual basis, as per the existing government tariff. The Contractor shall have to install energy meters as per the direction of EIC at their own cost.

5.2.4. LAND FOR CONTRACTOR'S SITE ESTABLISHMENTS

To the extent possible, the Owner shall try to provide to the Contractor, land within the Site, for the establishment of its site; otherwise the Contractor shall have to make necessary arrangements in this regard. In the event the site of Contractor's establishment is required to be shifted because of Site conditions, the same has to be done by Contractor without any additional cost to Owner. If the Contractor has to make arrangements for Contractor's site on lease basis, the Owner shall reimburse the Contractor the lease rentals and such other costs directly associated with the lease, subject to prior written approval from the Owner.

5.2.5. TELEPHONES

The Contractor shall make his own arrangements for telephone, fax and telex facilities as required for timely completion of the work at his own cost.

5.2.6. COORDINATION OF WORK

(a) The Contractor shall coordinate the works of various agencies engaged at Site to ensure minimum disruption of work carried out by different agencies. It shall be the responsibility of the Contractor to plan and execute the Works strictly in accordance with instructions of the Engineer-In-Charge to avoid hindrance to the work being executed by other agencies.

(b) The infrastructure facilities mentioned in Clause 1.2 to 1.5 above shall be arranged after the Engineer-In-Charge certifies in writing that the above facilities are required by the Contractor for the execution and maintenance of works under the Contract. The Engineer-In-Charge shall also certify the estimated quantities before start of the work and the quantities actually used every month by the Contractor.

5.2.7. LABOUR COLONY

The Contractor shall be responsible for providing space for accommodation to its labour and staff (including Sub-Contractor's labour and staff) which shall not be located at the Site premises.

SUB-SECTION- III

5.3. GENERAL OBLIGATIONS

5.3.1. INTERPRETATION OF CONTRACT DOCUMENTS

The Purchase Order, Agreement, Special Conditions of Contract, General Condition of Contract, Scope of Work, Site Facilities, Specification, Schedules and Drawings shall prevail over those of any other documents forming part of the Contract. The documents forming the Contract are to be taken as mutually explanatory. Should there be any discrepancy, inconsistency, error or omission in the Contracts or any of them, the matter may be referred to Engineer-In-Charge who shall give his decision and issue to the Contractor instructions in writing directing in what manner the Work is to be carried out. The decision of the Engineer-In-Charge shall be final and conclusive and the Contractor shall carry out Work in accordance with this decision. In case of ambiguities or discrepancies, the same shall be explained and addressed by the Owner, who shall thereupon issue to the Contractor instructions thereon and in such event, unless otherwise provided in the Contract, the priority of the documents forming the Contract shall be as enlisted below:

a) The Contract (if completed)
b) SCC
c) GCC
d) Purchase Order
e) BOQ & Specifications
f) Drawings
g) Any other document forming part of the contract

collectively, the "**Contract Documents**".

Works shown upon the Drawing, but not mentioned in the Specifications or described in the Specifications without being shown on the Drawings, shall nevertheless be held to be included in the same manner as if they had been specifically shown upon the Drawings and described in the Specifications.

5.3.2. SPECIAL CONDITIONS OF CONTRACT

5.3.2.1. The SCC shall be read in conjunction with the GCC, Specifications, Drawings and any other documents forming part of the Contract Documents, wherever the context so requires.

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

5.3.2.3. Wherever it is mentioned in the Specifications that the Contractor shall perform certain work or provide certain facilities, it is understood that the Contractor shall do so at his cost, or as per terms of the Purchase Order and mutual agreement.

5.3.2.4. The materials, design and workmanship shall comply with the Specifications including the relevant IS codes referred to. Where the job specifications stipulate requirements in addition to those contained in the IS Codes (or other standard codes and specifications), such additional requirements shall also be satisfied.

5.3.3. TIME OF PERFORMANCE

5.3.4. The work covered by this Contract shall be commenced within the period as specified in "the tender instruction and information" form after the receipt of the letter of award of Tender and shall be completed in stages on or before the dates as mentioned in the Time Schedule, as agreed by the Parties.

5.3.5. Contractor shall prepare a detailed weekly / monthly construction programme within ten days of receipt of Purchase Order. The Work shall be executed strictly as per the Time Schedule. The period of construction given includes the time required for testing, rectifications, if any, retesting and completion in all respects in accordance with the Contract and to the entire satisfaction of the Engineer-In-Charge.

5.3.6. Monthly / weekly construction targets shall be drawn up by the Contractor based on availability of work fronts and the construction programme as per above paragraph, indicating the resources necessary to achieve these targets. The Contractor shall scrupulously adhere to these targets and programme and shall deploy personnel, construction equipment and aides, as agreed, or as may be necessary. Contractor shall also procure on its own all the materials under the scope of supply in proper time, so that no activity of Work is adversely affected for want of material and to achieve the targets / programmes. In all matters concerning setting out targets, activities, priorities for the weekly and monthly programme and the progress achieved, the decision of the Engineer- in-Charge shall be final and binding on the Contractor. Contractor shall deploy a planning engineer who shall carryout only planning function and shall not be utilised for supervision of work. A detailed programme including the labour histogram, logistics plan, mobilisation of men and machinery ("Master Construction Programme") needs to be submitted to the Engineer-In-Charge for approval within 15 days of Purchase Order. Contractor shall have sufficient number of supervising staff for each discipline of work as per Site's organisation chart. If required, Contractor shall mobilize additional manpower at no extra cost to the Owner. Contractor shall also provide to the Engineer-In-Charge, the daily progress report and the chart of labour force deployed at Site / intended to be deployed in the coming week.

5.3.7. REPORTS & RECORDS

5.3.7.1. Within 15 Days of issue of the LOA (as defined in the Special Conditions of Contract), the Contractor shall prepare and submit for the approval of the Owner, a Construction Master Programme showing the stages and timelines with respect to commencement and completion of all Works in the necessary sequence based on interdependencies. The communications, planning and the control shall be extended to embrace all the contributing Sub-Contractors and integrate them in one. Continuous cost / performance analysis at frequent intervals will be made for corrective actions and updating the Construction Master Programme.

5.3.7.2. Within seven (7) days of issue of the LOA, the Contractor shall submit to the Owner and the Project Manager, a detailed construction programme in the form of CPM or PERT for the works, in the form of Gantt Chart showing the critical phases of the Works relating closely to the Master Construction Programme. As and when directed by the Owner, necessary revisions shall be carried out by the Contractor, including the incorporation or milestones that need to be met within specified timelines, when the Works progress, however, the Time Schedule shall not be extended, in any manner whatsoever, without the prior written consent of the Owner.

5.3.7.3. Along with the construction programme, the Contractor shall also submit in detail the following Schedules:

(a) Good for Construction Drawings Schedule
(b) Manpower Schedule
(c) Plant and Equipment Schedule
(d) Materials Schedule (including status and mobilisation programme)
(e) Materials Samples Schedule
(f) Shop drawings schedule (including status and delivery)

5.3.7.4. The Contractor shall, from time to time maintain at each job site (in addition to any records or registers required to be maintained by the Contractor under any Applicable Law) such records and registers as the Engineer-In-Charge shall or may require the Contractor to keep and / or maintain from time to time.

5.3.7.5. In addition to any other records or registers to be maintained by the Contractor from time to time and / or reports to be furnished by the Contractor, the Contractor shall daily or otherwise as may be prescribed by Engineer-In-Charge or Site Engineer, submit to the Site Engineer a progress report of all Works completed and / or progress achieved by the Contractor within the preceding day or the period of last report, as the case may be.

5.3.7.6. Notwithstanding the above, the Contractor shall submit the following reports to the Owner:

a) Daily report of number of employees / labour engaged by the Contractor with classification of their jobs/trades, details of new employees / labour engaged (together with their identification proof) (“Contractor Personnel Report”).
b) Weekly progress report containing the progress of work, schedule completion time, variance from the schedule and the proposed revised schedule of completion and detailing actual or potential delay in any work, classifying the reasons of delay (“Weekly Progress Report”).

c) Daily report of critical activities including mobilization and commissioning of plant and machinery (initial stage), and mobilization of skilled manpower and materials.

d) Monthly progress report containing the progress of work, schedule completion time, variance from the schedule and the proposed revised schedule of completion and detailing actual or potential delay in any work classifying the reasons of delay ("Monthly Progress Report")

5.3.7.7. All records and registers of the Contractor shall be produced to the Engineer-In-Charge or his authorised representative in case of demand for inspection and verification.

5.3.7.8. The receipt and / or acceptance of any such report by the Engineer-In-Charge shall be without prejudice to the full rights and remedies of the Owner and obligations / liabilities of Contractor under the Contract, and shall not anywise operate as an estoppel against Owner by reason only of the fact that no notice or objection was taken of any information contained in any such report, nor shall any statement in any such report be deemed to be correct merely by virtue of the existence of such statement, and it being uncontroverted by the Owner / Engineer-In-Charge.

5.3.8. FORCE MAJEURE

5.3.8.1. The Affected Party shall be excused from and not considered to be in default in the performance of its obligations under this Contract if such performance is prevented or delayed due do Force Majeure till such Force Majeure continues and to the extent that the Affected Party's performance of such obligations is prevented, hindered or delayed. Notwithstanding anything to the contrary contained in this Agreement, the Affected Party shall be excused from its obligations as set out in this Clause 4 provided that: (a) it shall comply with the requirements under Clause 4.2 and Clause 4.3; (b) the suspension of performance shall be of no greater scope and of no longer duration than is reasonably required by the Force Majeure; and (c) as soon as the Affected Party is able to resume performance of its obligations under the Contract, it shall give to the other Party notice to that effect and shall promptly resume performance of its obligations hereunder.

5.3.8.2. If either Party is prevented or delayed in the performance of its obligations hereunder by Force Majeure as provided for in Clause 4.1 above, and if the affected Party has given a written notice as soon as reasonably possible (but in any event within seven (7) days from the date of occurrence of the event of Force Majeure) to the other Party specifying: (a) the nature of Force Majeure; (b) the impact of such Force Majeure on the performance of the affected Party's obligations under the Contract; (c) the efforts made by the affected Party to prevent or overcome the impact of the Force Majeure on the Affected Party's operations; and (d) an estimate of the further period during which such factors are likely to continue. The Affected Party shall be excused from the performance of such obligations that have been directly affected by such Force Majeure from the date of such notice till the relevant Force Majeure conditions no longer continue (or to such earlier date as such conditions reasonably could have been abated through the exercise of due diligence and good faith efforts).

5.3.8.3. The Affected Party shall make all reasonable and diligent efforts in preventing, mitigating or limiting the damage arising out of or as a result of the existence or occurrence of such Force Majeure and to cure the same with due diligence. Upon receipt of a notice from either Party, the Parties hereto, shall mutually agree upon a course of action to remove or alleviate the effect of such effect.

a.

5.3.8.4. Subject to Clauses 4.1 and 4.2 above, Owner and Contractor shall not be liable to each other for any costs, loss or damage (including indirect and consequential damages) caused or suffered by them, due to a Force Majeure event.

5.3.8.5. If a Force Majeure event delays or appears likely to delay the performance of the work or the completion of Work, for an aggregate period of 90 (ninety) days, then Parties shall consult each other and shall consider action to be taken in the prevailing circumstances. If after all diligent efforts the Force Majeure continues for an aggregate period of 120 (one hundred and twenty) days, the Owner may, at its discretion, terminate the Contract by issuing a termination notice to the Contractor and upon issue of such termination notice, the Contract Agreement shall, notwithstanding anything to the contrary contained herein, stand terminated forthwith.

5.3.9. VARIATION / CHANGE OR ALTERATION IN THE WORKS

5.3.9.1. The Owner shall have the following rights

(i) The Owner / Engineer-In-Charge shall, by a written order ("**Variation Order**"), have the right during the performance of the Contract to order the Contractor to make any change, modification, addition or deletion to, in or from the Works, Specifications, designs, Drawings or Contract Documents including any additions, substitutions, deletions and / or rescheduling to all or any of the part of the Works under the Contract Documents ("**Variation**").

(ii) Notwithstanding the aforesaid, no change required to be made on account of any default, failure or neglect of the Contractor in the performance of its

obligations under the Contract Documents (including any default in the Specifications, designs, Drawings or Contract Documents supplied by the Contractor or due to any misrepresentation, omission, failure or neglect of the Contractor), shall be deemed to be a Variation, and the Contractor shall be bound to carry out alterations in accordance with the instructions given by the Owner / Engineer-In-Charge without any adjustment of the Contract Price or the Time Schedule.

(iii) The Owner may, by issue of a Variation Order: (A) increase or decrease the quantity of any Work included in the Contract or omit any such Work or change the character or quality or kind of any such Work; (B) change the levels, lines, position and dimensions of any part of the Works; (C) execute or cause to be executed through the Contractor any additional Work of any kind necessary for completion of the Works; (D) change any specified sequence or timing of construction of any part of the Works.

5.3.9.2. The Contractor shall not vary or alter any of the Works, except in accordance with a Variation Order from the Owner.

5.3.9.3. The time for carrying out and implementing such Variation in the Scope of Works, Specifications, designs, Drawings or Contract Documents shall be extended subject to the Owner's prior written consent and in accordance with procedure mentioned in Clause 5.4subject to Clause 5.5 below.

5.3.9.4. If the Owner proposes a Variation, it shall send to the Contractor a "**Request for Change Proposal**", requiring the Contractor to prepare and furnish to the Owner as soon as reasonably practicable a "**Variation Proposal**", which shall include the following:

(a) brief description of the Variation;
(b) effect on the progress of Works and schedule for completion;
(c) estimated cost of the Variation; and
(d) effect on any other provision of the Contract Agreement.

5.3.9.5. Upon receipt of the Variation Proposal, the Owner and the Contractor shall mutually agree upon all matters therein contained including agreement on rates (in the manner provided under Clause 5.6 below). Thereafter, the Owner shall, if it intends to proceed with the Variation, issue the Contractor with a Variation Order.

5.3.9.6. The rates for such Variation shall be worked out in accordance with the following provisions:

(a) All Variations shall be valued at the rates and prices set out in the Contract if the same shall be applicable. If the Contract does not contain any rates or prices applicable to the Variations, the rates and prices in the Contract shall be used as the basis for valuation so far as may be reasonable, if the varied item can be derived from a quoted item. If the Variation cannot be derived from any of the quoted item, the rates shall be based on market rates of materials delivered at Site plus reasonable wastage plus labour plus 15% percentage to cover overheads, profits and Taxes as applicable. Until such time as rates or prices are agreed or fixed by the Owner, the Owner may instruct the Contractor to proceed with the Variation basis provisional rates or prices as determined by the Owner to enable on-account payment to be included in the running bills and the Contractor shall immediately proceed with effecting the Variations covered by such order and shall not suspend or delay execution of the Variation

pending finalisation of rates or prices by the Owner. For the avoidance of doubt it is clarified that the Contractor cannot claim any extra amount / rate due to non-finalisation of rates in time.

(b) It should be as defined in the relevant clause under the heading "Extra Item" in Special Conditions of Contract.

5.3.9.7. The Contractor agrees that there may be substantial Variation, either plus or minus, in the quantities of the items of Work. Contractor shall take due consideration of this. No claims for loss or escalation on the grounds of increase / decrease in the quantities indicated in the schedule of quantities under the Tender will be permitted under this Contract.

5.3.9.8. The opinion of the Owner / Engineer-In-Charge as to current market rates of materials and the quantum of labour involved per unit of measurement shall be final and binding on the Contractor.

5.3.10. EXTENSION OF COMPLETION / TIME SCHEDULE

5.3.10.1. **Grounds for Extension of Time**

a) The Contractor shall be entitled to an extension of time to the schedule for completion as set out in **Annexure [·]Time Schedule**, under discretion of EIC in the following cases, except if such delays are attributable to the Contractor (including the Contractor's staff, labour and the Sub-Contractor's labour and staff):

(i) any Variation directed by the Owner by way of a Variation Order issued in accordance with Clause 5 above, if such Variation Order allows extension;

(ii) any material default or failure on the part of the Owner in performing its obligations under the Contract;

(iii) occurrence of Force Majeure as provided in Clause 4 above;

(iv) any instruction of the Owner to suspend whole or part of the Works for reasons not attributable to the Contractor.

(v) by reason of proceedings or disputes with the owners / tenants of adjoining parcels of land or public authorities arising otherwise than as a result of the Contractor's (including the Contractor's staff, labour and the Sub-Contractor's labour and staff) acts, omissions or defaults.

(vi) by reason of civil commotion, state-wide or industry wide strike of workmen or lock-out affecting any of the building trades other than involving the staff and labour of the Contractor (or Sub-Contractor).

b) In case of a claim for the reasons listed under Clause 6.1(a) above, the Contractor shall be entitled to an extension of time for such period as shall be fair and reasonable in all the circumstances and as shall fairly reflect the delay or impediment sustained by the Contractor (such extension referred to as "**Extension of Time**").

c) The Contractor shall submit to the Owner, a written notice of a claim for an Extension of Time, together with particulars of the event or circumstance justifying such extension as soon as reasonably practicable after the commencement of such event or circumstance. As soon as reasonably practicable after receipt of such notice and supporting particulars of the claim,

the Owner shall grant the Extension of Time to the Contractor for such period of time as may be considered reasonable and fair, in the Owner's opinion.

d) The Contractor shall not be entitled to any financial compensation or compensation in any form in respect of any extension of time granted by the Owner.

e) The Contractor shall at all times use its reasonable efforts to minimize any delay in the performance of its obligations under the Contract.

f) Notwithstanding anything to the contrary, it is agreed between the Parties that non-availability of raw materials for the Works by the Contractor shall not be a ground for Extension of Time.

5.3.10.2. **Extension of Time**

If extension is allowed under the terms of this Contract, the Contractor shall give notice to the Owner at least 3 (three) months before the completion date as per detail of Clause of Special Conditions of Contract under heading "Extension Of Time Completion", stating the occurrence and nature of such event, the length or anticipated length of the delay, the steps taken by the Contractor to keep the delay as minimal as possible.

5.3.10.3. **GRANT OF EXTENSION**

As soon as reasonably practicable and on receipt of the notice, the Owner shall grant the Contractor, from time to time in writing prospectively, such extension to the relevant Completion Time / schedule for completion as shall be fair and reasonable. The decision of the Owner regarding the Extension of Time shall be final and binding on the Contractor.

5.3.10.4. **LIQUIDATED DAMAGES**

5.3.10.4.1 Without prejudice to any other rights or remedies available to the Owner under the Contract or in law, if Contractor, for any reason other than Force Majeure, suspension of work by Owner not due to the Contractor's fault or Variation, not due to the Contractor's default and for which a Variation Order has been issued in accordance with Clause 5.1, fails to achieve the targets specified in the approved Programme Schedule by their due date or fails to complete the Work in accordance with the Time Schedule as set out in Annexure [·], Contractor shall be liable to pay to Owner, liquidated damages in an amount equivalent towards the rate of percentage of the Total Contract Value as specified in Purchase Order. The above liquidated damages as mentioned herein above shall, if applicable in the Contract, also be equally applicable in case of failure to achieve interim milestone, at the sole discretion of Owner and as may be specified in the Purchase Order.

5.3.10.4.2 Owner may, at its sole discretion, and without prejudice to its right to recover any or all of the liquidated damages by any other method of recovery, deduct the amount of such liquidated damages from any monies due or which may become due to Contractor.

5.3.10.4.3 The Parties agree that the liquidated damages payable by the Contractor pursuant to this Clause 8.3 shall be an agreed pre-estimation of damages ,and the compensation contemplated is not by the way of penalty.

5.3.10.4.4 The payment or recovery of sums hereinabove shall not relieve Contractor from any of its other duties, obligations, responsibilities, and liabilities under the Contract.

5.3.10.5. **NO COMPENSATION FOR ALTERATION OR RESTRICTION OF WORK**

If at any time from the commencement of the Work, the Owner shall for any reason whatsoever, not require any part of the Scope of Work as specified in the Tender / Contract to be carried out, then in that event, the Engineer-In-Charge shall give notice in writing of the fact to the Contractor, who shall save and except the charges or expenses incurred by him for such alteration or restriction of Work, which charges and expenses shall be approved by the Engineer-In-Charge, have no other claim to any payment or compensation whatsoever, including on account of any profit or advantage which he might have derived from the execution of the Work in full.

5.3.10.6. **OWNER NOT BOUND BY PERSONAL REPRESENTATIONS**

The Contractor shall not be entitled to any increase on the schedule rates or any other right or claim whatsoever by reason of any representation, explanation or statement or alleged representation, promise or guarantees given or alleged to have been given to him by any Person other than as may be provided by the Owner in writing (including any amendments to the Agreement).

5.3.10.7. **CONTRACTOR'S OFFICE AT SITE**

5.3.10.7.1 The Contractor shall provide and maintain an office at the Site for the accommodation of the Contractor's Personnel and such office shall be open during working hours on all Working Days to receive instructions, notices or other communications.

5.3.10.7.2 The Contractor shall obtain the prior approval of the Owner and the Consultant (including with respect to the location of the office) prior to commencing any works towards establishment of the office. At any time during the Contract Period, if the Owner is of the opinion that the Contractor's office obstructs or would likely obstruct any activities, operations, or works being carried out or proposed to be carried out on the Site, whether in relation to the Works or otherwise, the Contractor shall re-locate the office to such other location, as the Owner may direct, and the costs of relocation shall be borne by the Parties, in a manner as may be mutually agreed.

5.3.10.7.3 Such office established by the Contractor shall be removed from the Site within seven (7) days on completion of all Works under the Contract, at his own cost.

5.3.10.7.4 The office established by the Contractor pursuant to this Clause 11 shall contain all necessary infrastructure to enable to the Contractor (and the Contractor's Personnel) to perform their obligations under this Contract and sufficient space to accommodate 15 people with 20-seater meeting room.

5.3.10.8. **CONTRACTOR'S REPRESENTATIVE, SUBORDINATE STAFF AND THEIR CONDUCT**

5.3.10.8.1 The Contractor shall designate an individual "Contractor Representative who shall be responsible on the Site on behalf of the Contractor from the commencement of the Works and during the Defects Liability Period and continue to supervise and receive instructions related to Site activities given by or on behalf of the Engineer-In-Charge / Owner. The Contractor's Representative shall give his whole time to the superintendence of the works, receive on behalf of the Contractor, directions and instructions from the EIC, the Architect or the Engineering Consultant and shall be responsible to carry out such work in accordance with such directions and instructions received. The Contractor's Representative shall be present during normal working hours at the Site except when on leave, sick or absent for reasons beyond his control. The Contractor shall obtain the approval of the Owner / Engineer-In-Charge of the person so appointed as Contractor's Representative and shall not replace or remove such person without prior written consent of the Owner / Engineer-In-Charge, which consent shall not be unreasonably withheld or delayed. Apart from the Contractor's Representative, independent floor managers would be assigned to the different floors for supervision and co-ordination of works throughout the execution of the Project.

5.3.10.8.2 The Contractor, on award of the Work shall name and depute a qualified engineer having sufficient experience in carrying out work of similar nature, to whom the equipment, materials, if any shall be issued and instructions for works given. Whenever in the opinion of the Engineer-In–Charge, additional properly qualified supervisory staff is considered necessary, they shall be deployed by the Contractor at the Site within [·] days of a notice being received by the Contractor in this regard, without additional charge on account thereof to Owner. The Contractor agrees and acknowledges that such Representative and subordinate staff shall provide competent and efficient supervision, over the work entrusted to them and the same shall be to the satisfaction of the Owner / Engineer-In-Charge.

5.3.10.8.3 The Contractor shall be responsible for the proper behaviour of all the Contractor's Personnel, and shall exercise a proper degree of control and supervision over them and in particular and without prejudice to the said generality, the Contractor shall be bound to prohibit and prevent any of the Contractor's Personnel from trespassing or acting in any way detrimental or prejudicial to the interest of the community or of the properties or occupiers of land and properties in the neighbourhood of the Site, and in the event of such Contractor's Personnel so trespassing, the Contractor shall be responsible thereof and relieve the Owner of all consequent claims or actions for damages or injury or any other grounds whatsoever. The decision of the Engineer-In-Charge upon any matter arising under this Clause 12.3 shall be final.

5.3.10.8.4 If and whenever any of the Contractor's Personnel shall, in the opinion of Engineer-In-Charge, be guilty of any misconduct or be incompetent or insufficiently qualified or negligent in the performance of their duties or that, in the opinion of the Owner or the Engineer-In-Charge, it is undesirable for administrative or any other reason for such Contractor's Personnel to be employed in the Works, the Contractor, if so directed by the Engineer-In-Charge, shall at once remove such Contractor's Personnel from employment and / or terminate all contractual arrangements with such Contractor's Personnel in relation to the execution of the Works (in the event such Contractor's Personnel is a Sub-Contractor of the Contractor). Any Person so removed from the Works pursuant to this Clause 12.4 shall not again be employed in connection with the Works without the prior written permission of the Engineer-In-Charge / Owner. Any person so removed from the Works shall be immediately replaced at the expense of the Contractor by a qualified and competent substitute.

5.3.10.8.5 All Contractor's Personnel entering upon the Site shall be properly identified by badges / tokens of a type acceptable to the Owner which must be worn at all times when on the Site.

5.3.10.9. **ASSIGNMENT / SUB-LETTING OF WORK**

5.3.10.9.1 No part of the Contract, nor any obligation, share or interest therein, shall in any manner or degree be assigned, transferred, sub-contracted or sublet by the Contractor directly or indirectly to any Person whosoever except as provided for in Clause 13.2, without the prior consent in writing, of the Owner. However, if such consent is given by the Owner, such consent shall not relieve the Contractor from any liability or obligation under the Contract and the Contractor shall be responsible for the acts, defaults and neglects of the assignee, Sub-Contractor(s), agents, employees or workmen as fully as if they were the acts, defaults or neglects of the Contractor or the Contractor's Personnel.

5.3.10.10. **LIST OF SUB-CONTRACTORS TO BE SUPPLIED**

On the first day of every month, the Contractor shall furnish to the Engineer-In-Charge for his approval a list of all Contractor's Personnel (other than its own employees and staff) and working at the Site during the previous month with particulars of the general nature of the sub-contract or Works.

5.3.10.11. **SPECIALIST AGENCIES**

The Contractor may entrust specialist items of Work to the agencies specialized in the specified trade. Before appointing such agencies / firms, the Contractor shall submit the names and details of such agencies / firms whom he is going to employ for approval of EIC. These details shall include the expertise, financial status, technical manpower, equipment, resources, and list of works executed and on hand of the specialist agency.

5.3.10.12. **ASSIGNMENT BY THE OWNER**

In addition to the right of the Owner to assign the benefits of this Contract to any third party ([without] the requirement to obtain any approval whatsoever under this Contract), the Contractor hereby consents to the creation by the Owner of a security assignment of the Contract in favour of any Financing Entity (or a trustee acting on behalf of one or more Financing Entities) and hereby undertakes to execute upon the request of the Owner such documents as may be reasonably and customarily required to give effect to any such assignment, provided that the Contractor's consent, which shall not be unreasonably withheld or delayed, shall be required for the inclusion in such documents of any terms other than a simple confirmation of the consent given above or a simple acknowledgement of a notice of an assignment pursuant to this Clause. Any stamp duty and all costs and expenses payable in respect of such documents shall be to the account of the Owner in respect of any such documents required to be signed by the Contractor.

5.3.10.13. **POWER OF ENTRY AND EXPULSION OF THE CONTRACTOR**

If the Contractor does not commence the Work in the manner as is provided for in the Contract Documents or if he at any time in the opinion of the Engineer-In-Charge:

5.3.10.13.1 fails to carry out the Works in conformity with the Contract Documents, or

5.3.10.13.2 fails to carry out the Works in accordance with the Time Schedule, or

5.3.10.13.3 substantially suspends the whole or any part of the Work for a period of seven (7) days without prior written consent from the Engineer-In-Charge, or

5.3.10.13.4 fails to carry out and execute the Works in accordance with the Contract and to the satisfaction of the Engineer-In-Charge, or

5.3.10.13.5 fails to supply sufficient or suitable plants and equipment, temporary works, labour, materials or things, or

5.3.10.13.6 commits or suffers, or permits any other breach of any of the provisions of the Contract on his part to be performed or observed, or persist in any of the above mentioned breaches of the Contract for seven (7) Days, after notice in writing shall have been given to the Contractor by the Engineer-In-Charge requiring such breach to be remedied, or

5.3.10.13.7 if the Contractor shall abandon the Works, or

5.3.10.13.8 if the Contractor during the continuance of the Contract shall become bankrupt, make any arrangement or composition with his creditors, or permit any execution to be levied or go into liquidation whether compulsory or voluntary, not being merely a voluntary liquidation for the purpose of amalgamation or reconstruction. In any such case, the Owner shall have the power to enter the Site, expel the Contractor and take over the Works and take possession of the materials, temporary works, tools, plants and equipment and such other stock thereon, and to complete the Works by either by itself (including through the authorised representative of the Owner) or such other Person ("Third Party Contractor") as the Owner in his absolute discretion may think proper to employ and for the purpose aforesaid to use or authorise the use of any materials temporary works, plants and equipment and stock as aforesaid. In the event such materials, temporary works, tools, plants and equipment are procured by the Contractor from any third party, any expenses, losses or charges suffered by the third party on account of taking over of such materials, temporary works, tools, plants and equipment by the Owner shall be borne by the Contractor and the Contractor agrees to indemnify the Owner in this regard. The Owner shall be entitled to retain possession of such materials, temporary works, tools, plants and equipment at all times after taking over and till the Works have been completed by such Person as appointed by the Owner pursuant to this Clause 14.8. Further, on such taking over of the Works by the Owner, the Contractor shall be entitled to receive payment or allowance, as may be certified in writing by the Engineer-In-Charge to be due and payable only for the portion of Works completed. Any costs and expenses incurred by the Owner by reason of his taking possession of the Works or of the Works being completed by itself or through the Third Party Contractor, shall be deducted from any money which may be due for work done by the Contractor under the Contract and not paid for. Any deficiency in regard to the same shall forthwith be made good and paid to the Owner by the Contractor.

5.3.10.14. **CONTRACTOR'S RESPONSIBILITY**

The Contractor shall have to execute the Work in such place and condition where other agencies engaged by the Owner for other works including site grading, filling, and levelling, electrical and mechanical engineering works are also being carried out. No claim shall be entertained due to Work being executed in the above circumstances.

5.3.10.14.1 The Contractor shall execute and maintain the Works with due care and diligence and shall provide all materials, labour including supervision thereof, constructional plant, temporary works, transport and all other things, whether of temporary or permanent nature, required for the proper execution and maintenance of the Works.

5.3.10.14.2 The Contractor shall execute the whole and every part of the Works in the most substantial and workmanlike manner, both as regards materials and labour and otherwise in every respect in strict accordance with the Specifications and Good Industry Practice. The Contractor shall conform exactly, fully and faithfully to the designs, Drawings and instructions relating to the Work, in writing.

5.3.10.14.3 Before commencing any item of Work, the Contractor shall co-relate all relevant drawings and information and satisfy themselves that the information available thereof is complete, unambiguous and without any discrepancies. The Contractor shall be responsible for any errors in the execution of the Works and / or damage caused due to any discrepancy in the Drawings and other documents, which was overlooked by the Contractor and / or their Sub-Contractor and is not brought to the notice of the EIC.

5.3.10.14.4 Contractor shall thoroughly study all the Drawings in advance on receipt of the same and in case of any discrepancies and detailing required pertaining to the drawing, Contractor shall immediately notify the EIC. Any revision in Drawing or detailing issued in response of such query shall not be considered as any change in Drawing.

5.3.10.14.5 Levels, dimensions and other information shown on the Drawings are believed to be correct. The Contractor shall, however, verify them for themselves and no claim or allowance whatsoever shall be entertained on account of any errors or omissions in the levels, dimensions or any other deviations from those shown in the drawings. Written dimensions to be followed. No scaling shall be permitted.

5.3.10.14.6 Any loss or damage caused by negligence of the Contractor to the materials, whether procured by the Contractor or the Owner, shall be to the account of the Contractor.

5.3.10.14.7 Any loss or damage caused by the Contractor and the Contractor's Personnel to the structure and / or services of the building including any damage caused to the curtain walls and glass panes shall be to Contractor's account and would be recovered from them through deductions from their Running Account Bill.

5.3.10.14.8 The Contractor shall submit an organization chart, specific to the Project, qualification of the Contractor's Personnel including number of skilled and unskilled people that the Contractor would be employing to this Project and the single point of contact / person responsible for the overall Project, safety, billing and procurement, detailed procurement schedule accompanied by a Project Schedule Gantt / PERT chart along with the Tender.

5.3.10.15. **Details of Construction Not Specifically Mentioned and Minor Changes**

Rates quoted shall be deemed to allow for all constructional details which may not have been specifically described in the BOQ under this Contract, shown on the Drawings or given in the Specifications, but are essential for the execution of the Work and performance by the Contractor of its obligations under the Contract. Details of constructions not specifically shown in Drawings or Specifications shall be furnished to the Contractor or by the Contractor during the execution of the Work. In case of any difference of opinion between the Contractor and Architect, the EIC shall determine as to whether or not the item involved constituted a constructional detail or additional works and their decision shall be final and binding.

5.3.10.15.1 URGENT REPAIRS

If, by any reason of any accident, or failure, or other event occurring, either during the execution of the Works or during the Defects Liability Period, any remedial or other work or repair shall, in the opinion of the EIC, be urgently necessary for the safety of the Works, and the Contractor is unable or unwilling to do such work or repair, in such event the Owner may employ such other persons to carry out such work or repairs as the EIC may consider necessary. The Owner shall recover the costs and expenses incurred for carrying out such work or repairs from the Contractor or may be deduct such costs and expenses from any amount due or payable or which may become due or payable to the Contractor.

5.3.10.15.2 The Contractor shall take full responsibility for the care of Works, materials and plant for incorporation therein and shall take all necessary precautions to prevent loss or damage and to minimize loss or damage to the greatest extent possible that may happen to the Works, material and plant, from the commencement date until the date of issue of Final Completion Certificate, when the responsibility for the said care shall pass to the Owner. Provided that the Contractor shall take full responsibility for the care of any outstanding Works and materials and plant for incorporation therein which he undertakes to finish during the Defects Liability Period until such outstanding Works have been completed.

5.3.10.15.3 No part of the Works shall be covered up or put out of view without the approval of the Owner and the Contractor shall afford full opportunity for the Owner to examine and measure any such part of the Works which is about to be covered unto or put out of view and to examine foundations before any part of the works is placed thereon. The Contractor shall give a reasonable notice to the Owner whenever such part of the Works or foundations is or are ready or about to be ready for examination and the Owner shall, without unreasonable delay unless he considers it unnecessary and advises the Contractor accordingly, attend for the purpose of examining and measuring such part of the Works or foundations. Where the Works involved more than one stage / process, the Contractor shall give notice when each stage / process is ready to enable inspection by the Owner's representative.

5.3.10.16. **NOTICES:** All notices, requests, demands, consents, certificates, waivers, decisions, instructions and orders or other communications required to be given by either Party to the other pursuant to the Contract shall be in English and shall be served by sending the same by facsimile transmission courier, or by electronic mail (with a confirmation copy by registered courier or by hand delivery in case of major issues relating to the Contract, such as dispute resolution, claims and termination) to the other Party, or by hand delivery at the address below or such other address as each Party may communicate to the other Party in writing:

5.3.10.17. **Serving of Notices**

Any notice sent by facsimile transmission shall be deemed to have been served at the time of receipt, provided that a positive transmission report from the sender's machine shall be conclusive evidence of receipt in the absence of evidence to the contrary. Any notice sent on a public holiday in India, be deemed to have been served on the first Working Day after the date of the notice.

5.3.10.17.1 **Other Communications**

All other communications pertaining to the Contract shall be made between the Contractor and the Owner's representative or other representatives nominated by the Owner or the Owner's representative from time to time in

respect of such categories of communication and subject to such limits of authority as may be agreed as part of the project co-ordination procedures or as may be notified by the Owner from time to time.

5.3.10.18. **RIGHTS OF VARIOUS INTERESTS**

5.3.10.18.1 The Owner reserves the right to distribute the Work between more than one contractor. The Contractor shall cooperate and afford other contractors reasonable opportunity for access to the Works for the carriage and storage of materials and execution of their works and coordinate with such contractors to ensure that the Work of the Contractor and the other contractor(s) does not suffer.

5.3.10.18.2 Wherever any work being done by any department of the Owner or by other contractors employed by the Owner is contingent upon Work covered by this Contract, the respective rights of the various Persons involved shall be determined by the Engineer-In-Charge to secure the completion of the various portions of all works in general harmony.

5.3.10.19. **RIGHT OF OWNER TO DETERMINE / TERMINATE CONTRACT**

5.3.10.19.1 Upon the occurrence of any of the following events:

(i) the Contractor, despite having been notified by the Owner of any default under this Contract including failure to perform the Work, ensuring supply of sufficient Contractor's Personnel, suitable materials or equipment, or failure to adhere to the Time Schedule, fails to cure or rectify such default within [·] days;

(ii) the Contractor disregards any Applicable Laws or directions of any Governmental Authority, in the performance of its obligations under this Contract;

(iii) the Contractor disregards the authority or instructions of the Owner, Owner's representative, Engineer-In-Charge which authority and instructions are as per the provisions of this Contract;

(iv) the Contractor fails to render and perform all the Works in accordance with all the terms and conditions of the Contract;

(v) the Engineer-In-Charge gives notice to the Contractor that failure to correct a particular defect is a fundamental breach and the Contractor fails to rectify the same within [·] days of a notice being issued;

the Owner may, by a seven (7) days written notice and without prejudice to any other remedy if provided for under the Contract, terminate the services of Contractor, enter the Site, expel the Contractor (and the Contractor's

Personnel) therefrom and take possession of the Work and of all Contractor's tools, appliances, construction equipment and machinery at the Site and use the same to the full extent and in the manner as they could be used by Contractor and incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere, and finish the Work as Owner may deem expedient but without releasing the Contractor from all its obligations or liabilities which have accrued as at the date of termination of the Contract and without affecting the rights and powers conferred by the Contract on the Owner.

5.3.10.19.2 In such case, Owner shall be entitled to encash performance guarantee, or any other security deposit bank guarantee submitted by the Contractor and utilize the amounts to compensate against the losses, cost and damages as mentioned below.

5.3.10.19.3 In such case, Contractor shall not be entitled to receive any further payment until the Work is completed. If the unpaid balance of the Contract Price exceeds all claims, costs, losses, loss of business profit and damages sustained by Owner rising out of or resulting from completing the Work, such excess shall be paid to Contractor. If such claims, costs, losses and damages exceed such unpaid balance, the Contractor shall pay the difference to Owner. Such unpaid balance of the Contract Price, claims, costs, losses and damages incurred by Owner shall be reviewed, certified and approved by the by Engineer-In-Charge. If such amounts exceeds the sum which would have been payable to the Contractor on due completion by him, then the Contractor shall, upon demand, pay to the Owner the amount of such excess and it shall be deemed a debt due by the Contractor to the Owner and shall be recoverable accordingly. The Owner shall have option to sell the Contractor's equipment, temporary works, unused materials and other assets of the Contractor at Site and adjust the proceeds in satisfaction of the demand made on the Contractor.

5.3.10.19.4 On such termination, the Contractor shall be paid (without duplication of any items):

(i) for completed and acceptable Work executed in accordance with the Contract Documents prior to the effective date of termination;

(ii) for expenses sustained prior to the effective date of termination in performing services and furnishing labour, materials or equipment as required by the Contract Documents in connection with uncompleted Work and as certified by the EIC to have been reasonably done and as long as the Owner gets benefit of such expenses sustained; plus fair and reasonable sums for overhead and profit on such expenses to be decided by the Engineer-In-Charge, for reasonable expenses directly attributed to termination;

5.3.10.19.5 Immediate Termination of Contract

The Owner shall, upon occurrence of any or all of the following events, be entitled at any time to terminate the contract forthwith without stating any reason whatsoever:

(i) If the Contractor has abandoned the Contract without assigning any reasons, including demobilization of man and machinery without prior written consent of the Owner or Engineer-In-Charge;

(ii) The insolvency, dissolution or liquidated of the Contractor, or the filing of a petition in bankruptcy or commencement of insolvency resolution process by or against the Contractor, or the adjudication of Contractor as bankrupt, or any general assignment by Contractor for the benefit of its creditors, or the application for, or consent to, the appointment of any receiver, trustee, custodian or similar officer by Contractor.

5.3.10.19.5.1 The Contractor agrees and acknowledges that in the event of any termination, suspension or taking over of the whole or part of the Works by the Owner in accordance with the terms of this Contract, compensation in money shall be adequate remedy and if required by the Owner, the Contractor shall leave the Site (and shall ensure all the Contractor's Personnel vacate the Site), and hand over possession of the same along with the ancillary units, plants and equipment tools, materials and other construction plants brought in by the Contractor during the execution of the Works.

5.3.10.19.5.2 Upon the occurrence of any one of the following events:

- If there is hold for long duration by any Governmental Authority, beyond the period of suspension as provided in the Contract;
- If there is any kind of non approval for any reason whatsoever by any Governmental Authority, resulting into stoppage or hold for long duration beyond the period of suspension as provided in the Contract;
- If Owner doesn't want to execute the work due to any change of policy or implementation of existing policy by any Governmental Authority;
- If there is any change of relevant business scenario due to which Owner doesn't find it profitable to execute the Project; and
- If there is any long term paucity of fund to run the Project;

In such case, the Owner may, by a prior written notice of 30 (thirty) days, terminate the contract. Contractor shall vacate the Site (and shall ensure all the Contractor's Personnel vacate the Site) and remove all of his

plants, machineries and unused material, temporary infrastructure, etc. and hand over the site in clean condition. Contractor shall be entitled to receive payment against their work done value under BOQ items and for the other work as per provision in the Contract in their Final Bill. No payment or claim due to such termination in the form of any type of compensation or on account of any loss on profit, etc. shall be payable.

5.3.10.20. **PATENTS AND ROYALTIES**

The Contractor, if licensed under any patent covering equipment, machinery, materials or compositions of matter to be used or supplied or methods and process to be practiced or employed in the performance of this Contract, agrees to pay all royalties and licence fees which may be due with respect thereto. If any equipment, machineries, materials composition of matters, to be used or supplied or methods and processes to be practiced or employed in the performance of this Contract, is covered by a patent under which the Contractor is not licensed then the Contractor, before supplying or using the equipment, machineries, materials, composition method or processes, shall obtain such licenses and pay such royalties and licence fees as may be necessary for performance of this Contract. In the event the Contractor fails to pay any such royalty or obtain any such licence, any suit for infringement of such patents which is brought against the Contractor or the Owner as a result of such failure, shall be defended by the Contractor at his own expense and the Contractor shall bear and pay any damages and costs relating to or arising out of and / or awarded in such suit and Contractor shall indemnify Owner for all claims, losses, damages, what so ever arising from such claims. The Contractor shall promptly notify the Owner if the Contractor has acquired knowledge of any patent under which a suit for infringement could be reasonably brought because of the use by the Owner of any equipment, machineries, materials, process, and methods to be supplied hereunder. The Contractor agrees to and does hereby grant to Owner, together with the right to extend the same to any of the subsidiaries of the Owner as irrevocable, royalty-free licence to use, any invention made by the Contractor or the Contractor's Personnel in or as a result of the performance of the Work under the contract.

5.3.10.21. **LIENS**

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

5.3.10.22. **SETTLEMENT OF DISPUTES**

(a) If a dispute of any kind whatsoever arises between the Owner and the Contractor in connection with, or arising out of, the Contract or the execution of the Works, whether during the execution of the Works or after their completion and whether before or after repudiation termination of the Contract, including any dispute as to any opinion, instruction, determination, certificate or valuation of the Engineer-In-Charge, the matter in dispute shall, in the first place, be referred by the disputing party in writing to the Engineer-In-Charge, with a copy of the same to the non-disputing party. No later than the thirty (30) days from the date of receipt of such reference, the Engineer-In-Charge shall give notice of his decision to the Owner and the Contractor. Such reference and decision shall state that it is made pursuant to this Clause 20.1.

(b) During the period when the dispute and difference arose and the time taken by the Engineer-In-Charge to decide and communicate its decision to the Owner and the Contractor and thereafter unless the Contract has already been repudiated or terminated, the Contractor shall, in every case, continue to proceed with the Works with all due diligence and the Contractor and the Owner give effect forthwith to every such decision of the Engineer-In-Charge, unless and until the same shall be revised, as hereinafter provided, in an amicable settlement or an arbitral award.

(c) In the event the Owner or the Contractor is dissatisfied with any decision of the Engineer-In-Charge, or if the Engineer-In-Charge fails to give notice of his decision on or before the thirtieth (30^{th}) day from the day on which he received the reference, then either the Owner or the Contractor may, on or before the twenty fifth day (25) after the day on which he received notice of such decision, or on or before the twenty fifth (25^{th}) day from the day on which the said period of thirty (30) days expired, as the case may be, give notice to the other party, with a copy for information to the Engineer-In-Charge, of his intention to refer the dispute to arbitration and commencement of arbitration, as in the manner hereinafter provided. Subject to Sub-Clause under heading "Arbitration", it is hereby agreed that no such arbitration in respect thereof may be commenced unless such notice is given.

(d) If the Engineer-In-Charge has given notice of his decision as to a matter in dispute to the Owner and the Contractor and no notice of intention to commence arbitration as to such dispute has been given by either party, the Owner or the Contactor on or before the twenty fifth (25^{th}) day after the day on which the parties received notice as to such decision from the Engineer-In-Charge, the said decision shall become final and binding upon the Owner and the Contractor.

5.3.10.23. **Amicable Settlement**

Where notice of intention to commence arbitration as to the dispute has been given in accordance with Sub-Clause (c) of Clause 20.1 the parties shall attempt to settle

such dispute amicably before the commencement of arbitration. Provided that, unless the parties otherwise agree, arbitration may be commenced on or after the thirtieth (30th) day from the day on which notice of intention to commence arbitration of such dispute was given, even if no attempt at amicable settlement thereof has been made.

5.3.10.24. **Arbitration**

(a) If either the Owner or the Contractor or both do not agree to the decision of the Engineer-In-Charge wholly or in part relating to any dispute referred to Engineer-In-Charge, the same shall be finally referred to arbitration and be settled in accordance with the Arbitration and Conciliation Act, 1996.

(b) Each party shall be entitled to nominate one arbitrator each and the two arbitrators shall jointly nominate a third presiding arbitrator. The arbitrators shall give a reasoned award. The parties agree that any arbitration award shall be final and binding upon the parties.

(c) The place of arbitration shall be in Bangalore and the language of arbitration shall be English.

(d) The cost of arbitration shall be shared equally between both the parties.

(e) It is clarified that the Owner shall be entitled to retain any sum or portion of the Contract Price which has become due and payable, for any unfinished works or any subject matter under arbitration. Both Parties shall continue to perform their respective obligations under the Contract during the pendency of the arbitration proceedings, unless the Contract has been terminated or has come to an end.

5.3.10.25. During the period when a matter / dispute is referred to the decision of the Engineer-In-Charge, in the execution of the Works under the Contract, and if thereafter the matter is referred to Arbitration, the Contractor shall be bound by interim or final decision taken by the Engineer-In-Charge and continue to perform its obligations under this Contract, unless the same is stayed, modified or reversed by any interim or final award / order of the arbitrators.

5.3.10.26. **Failure To Comply** with **Engineer-In-Charge Decision**

Where neither the Owner nor the Contractor has given notice of intention to commence arbitration of a dispute within the period stated herein above and the related decision of Engineer-In-Charge has become final and binding, either Party may, if the other Party fails to comply with such decision, and without prejudice to any other rights it may have, refer the failure to arbitration.

5.3.10.27. **NOTICES**

(a) Service of Notices on Contractor:

Any notice to be given to the Contractor under the terms of the Contract shall be served by sending the same by registered post to the address provided under Clause 16 above.

(b) Service of Notices on Owner:

Any notice to be given to the Owner under the terms of the Contract shall be served by sending the same by registered post to or leaving the same at the Owner's last known address (or in the event of the Owner being a Company to or at its registered Office).

5.3.10.28. **CHANGE IN CONSTITUTION**

If, there is a change in the constitution of the Contractor firm, after or prior to the award of the Contract and if prior approval is not obtained, the Contractor shall have been deemed to have been assigned and Owner reserves the right to determine the Contract and the same consequence shall follow as if the Contract was determined on the Contractor's default.

5.3.10.29. **NON-WAIVER**

Any failure on the part of the Owner to insist upon strict performance of any terms or conditions of this Contract or failure or delay to exercise any rights or remedies provided herein or by law or failure to properly notify Contractor in the event of breach, or the acceptance of or payment for any goods or Works hereunder, or the review or failure to review designs shall not release Contractor from any of the warranties or obligations of this Contract and shall not be deemed a waiver of any right of Owner to insist upon strict performance hereof or any of its rights or remedies as to any prior or subsequent default hereunder, nor shall any termination of work under this Contract by Owner operate as a waiver of any of the terms hereof.

5.3.10.30. **LANGUAGE**

All documents, instructions, catalogues, brochures, pamphlets, design data, operation and maintenance manuals, communications shall be in English language.

5.3.10.31. **JURISDICTION**

The Contract shall be governed, construed and interpreted in accordance with the laws of India and in the event of any litigation the courts in Bangalore shall have exclusive jurisdiction.

5.3.10.32. **SECRECY**

5.3.10.32.1 All information gathered under this Contract by the Contractor, all reports and recommendations relating to this Contract shall be treated as confidential by the Contractor and the Contractor shall ensure that such reports and recommendations are treated as confidential by the Contractor's Personnel and shall not, without the prior written approval of Owner be made available to any person or party other than the EIC, the Architect, Engineering Consultant or any concerned Government Authority.

5.3.10.32.2 The Contractor shall take all necessary steps to ensure secrecy of information obtained in the course of the execution of the contract, which would or might be directly or indirectly of use to any business competitors of the Owner.

5.3.10.32.3 No photographs of the Owner's Works Site including the works to be carried out by the Contractor shall be taken by the Contractor, his employees or representative, without the prior written consent of the Owner, which consent shall not be unreasonable withheld or delayed.

5.3.10.33. **LIMITATION OF LIABILITY AND EXCLUSION OF DAMAGES**

Owner will be not liable for any indirect, or incidental or consequential damages of any type, including lost profits, or lost data, arising out of or in connection with this Contract or the services, even if it has been advised by the Contractor of the possibility of the damage and even if Contractor asserts or establishes a failure of essential purpose of any limited remedy provided in this Contract. The total liability of Owner shall not exceed the amount paid to Contractor in the twelve months (12) preceding the event causing such liability under this Contract.

5.3.10.34. **BUSINESS ETHICS AND ANTI-CORRUPTION COMPLIANCES**

In performing its duties and obligations under the Agreement, the Contractor hereby confirms, covenants and assures as follows:

(a) The Contractor shall ensure that all Persons (including the Contractor's Personnel) engaged in provided the Services under the Contract Documents and all its directors, officers and employees are in strict compliance with the provisions of all Anti-Corruption Laws and the Contractor shall maintain and enforce policies and procedures for: (i) preventing and assessing the risk of breaching Anti-Corruption Laws; and (ii) reviewing and monitoring any such risk.

(b) Without limiting the above, the Contractor hereby represents, warrants and covenants that, (a) the Contractor has read, is fully aware of and understands the provisions of the Anti-Corruption Laws; (b) the Contractor has and shall comply with the Anti-Corruption Laws, and has and will cause its representatives to comply with the Anti-Corruption Laws, in connection with the Contract Documents and the transactions and activities contemplated hereby; and (c) the Contractor agrees not to take, or permit to be taken, directly or indirectly, through any representative or otherwise, any actions which would subject itself or the other

Party, or any of their respective shareholders or Affiliates, or any of their respective officers, directors or employees, to any civil or criminal penalties or loss of benefits pursuant to the Anti-Corruption Laws.

(c) The Contractor shall not directly or indirectly offer, pay, promise to pay or authorize the payment of, or permit any representative to directly or indirectly offer, pay, promise to pay or authorize the payment of, any money or thing of value, such as providing gifts or entertainment, to any officer, employee or representative of any Governmental Authority, agency, legislature, court, political party, government-owned company or public international organization (a "**Governmental Official**") for the purpose of (i) influencing any act or decision of any Governmental Official, or (ii) inducing such Governmental Official to do or omit to do any act in violation of the lawful duty of such official, or (iii) inducing such Governmental Official to use his or her influence with a government or instrumentality thereof to affect or influence any act or decision of such government or instrumentality in order, in the case of (i), (ii) or (iii), to assist the other Party, its representatives, or any of their respective Affiliates in obtaining or retaining business, or directing business to such person, or assisting such person in obtaining any advantage.

(d) Notwithstanding anything to the contrary herein, in the event of a breach by the Contractor of its representations, warranties, and covenants in this Clause 28, the Owner may, by written notice to the Contractor, terminate the Agreement with immediate effect and the Agreement shall thereupon terminate with no further obligation, other than those that arose prior to the date of termination under this Clause 28, or that otherwise survive the termination of the Agreement.

SUB-SECTION- IV

5.4. PERFORMANCE OF WORK

All the Works shall be executed in strict conformity with the provisions of the Contract Documents and with such explanatory detailed Drawings, Specifications and instructions as may be furnished from time to time to the Contractor by the Engineer-In-Charge, whether expressly mentioned in the Contract Documents or otherwise. The Contractor shall be responsible for ensuring that Works throughout are executed in accordance with Good Industry Practice, the Specifications set out in the Contract Documents and to the entire satisfaction of the Engineer-In-Charge.

5.4.1. COORDINATION AND INSPECTION OF WORK

i. The coordination and inspection of the day-to-day work and operations of the Contractor under the Contract shall be as per direction of Engineer-In-Charge or his authorised representative. The written instructions regarding any additional job shall normally be passed by the Engineer-In-Charge or his authorised representative. A work order book shall be maintained by the Contractor in which the aforesaid written instructions shall be entered. These shall be signed by the Contractor or the Contractor's Representative by way of acknowledgement within 12 hours of the instructions.

ii. On and from commencement of Work, and from time to time, the Contractor shall confer with other contractors, sub- contractors, and persons engaged on separate contracts in connection with the Work, and with the Project Manager for the purpose of coordination and execution of the various phases of Work. The Contractor shall ascertain from the other contractors, sub-contractors and persons engaged in separate contracts, in connection with the Works, the extent of all chasing, cutting and forming of all openings, holes and grooves as may be required to accommodate the various services.

iii. The Contractor shall ascertain the routes of all services and the position of all floor and wall outlets, traps, etc. in connection with the installation of plant, services and arrange for the construction of Work accordingly. The breaking and cutting of the completed work must not be done unless specifically authorized in writing by the Site Manager. Generally, all breaking shall be by the Contractor for civil / interior work and no work shall be done over broken or patched work without first ascertaining that the broken surface is adequately prepared and reinforced to receive and hold further work.

5.4.2. CO-OPERATION WITH OTHER CONTRACTORS

i. The Contractor during the execution of the Works shall co-ordinate and provide all opportunities and access to the Site to other contractor(s) and agencies who may be employed by the Owner and to the personnel of such contractor(s) and agencies. The Contractor shall work in harmony with such

contractor(s) and agencies to ensure completion of Works in accordance with the approved Programme Schedule.

ii. In respect of the work of such other contractors and agencies, where the commencement or progress of such work of any other contractor(s) or agency is dependent upon the completion of particular portions of the Contractor's Works or generally upon the Contractor maintaining progress in accordance with the approved co-coordinated programme, it shall be the responsibility of the Contractor to complete such portions to ensure such progress and timely completion of the works.
In the event of any differences / disputes between the Contractor and the other contractors, and agencies, the same shall be referred to the Engineer-In-Charge, whose decision shall be final and binding on the Contractor and other contractors and agencies.

iii. The Contractor shall have to co-ordinate with agencies which are appointed by Owner for activities like water proofing, post tensioning, electrical works, plumbing and firefighting and for that agreed co-ordination charges shall be paid, unless and otherwise agreed upon earlier.

iv. The Contractor shall co-operate with other contractors, Engineer In-charge, Architect and Engineering Consultant and freely exchange with them such technical information as necessary for the proper execution of the works.

v. The Contractor shall, in accordance with the directions of the Project Manager / Site Manager, afford all reasonable opportunities to other contractors and their workmen and to the workmen of Owner who may be employed in the execution of the works not included in the Contract, for carrying out their work.

vi. All operations necessary for the execution of Works shall be carried out so as not to interfere unnecessarily or improperly with the execution of works by other contractors. Execution of Works under this Contract shall be co-ordinated with the work of other contractors where it would interfere with their work or working. The Site Manager and the concerned Contractor shall be informed well in time for effective coordination and proper execution of Works.

5.4.3. WORK IN MONSOON AND DEWATERING

5.4.3.1. The completion of the work may entail working during the entire year including the monsoon season as well. The Contractor must maintain an adequate labour force as may be required for the job and plan and execute the construction and erection according to the approved Programme Schedule. No extra rate shall be considered for Work executed during the monsoon season.

5.4.3.2. During monsoon season and other period, it shall be the responsibility of the Contractor to keep the Site free from water, and shall arrange necessary manpower, plant and machineries, at his own cost, to ensure the proper maintenance of the Site.

5.4.4. WORK AT NIGHT, SUNDAYS AND HOLIDAYS

5.4.4.1. Contractor shall perform Work on all days of the week (including Sundays and other public holidays), except if otherwise directed by Owner from time to time. Rates set out in the Schedule of Rates apply to all days including Sundays and holidays. If required, the Contractor shall obtain necessary permission from the relevant Governmental Authorities and neighbouring land owner to carry out the Work other than during normal working hours on Working Days and on public holidays.

5.4.4.2. The Contractor shall bear all costs and charges for special or temporary way leaves required by him in connection with the access to the Site. The Contractor shall also provide at his own cost any additional facilities outside the Site required by him for the purpose of the Works, or as per terms of the Purchase Order and mutual agreement.

The Contractor shall at all times keep the Site including Works being carried out, office, approach road and surroundings clean and tidy, free from dust, rubbish, scrap, surplus material and unwanted tools and equipment. All scaffolding and temporary structures shall be removed as soon as the job for which these are intended is complete. Owner has right to stop work if the Contractor fails to improve upon the house keeping after having been notified and other agencies shall be deployed at Contractor's risk and cost.

5.4.5. Prevention of Pollution:

The Contractor shall take all reasonable precautions to prevent pollution of water, air and the surroundings. Before any demolition work is commenced and also during the process of construction, following precautions shall be taken:

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

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

c. All practical precautions shall be taken to protect and prevent danger to persons employed at Work from risks of fire, explosions or flooding. Floor, roof or other parts of building shall not be overloaded with debris or materials to render it unsafe.

5.4.6. DRAWINGS TO BE SUPPLIED BY THE OWNER (3 SETS)

5.4.6.1. Where drawings are attached with Tender or Contract, these shall be only for the general guidance of the Contractor, to enable him to visualise the type of Work contemplated and Scope of Work involved, and shall be deemed to be the property of the Owner at all times. The Contractor shall be deemed to have studied the drawings and formed an idea about the Work and the manner in which it is to be carried out.

5.4.6.2. Detailed working drawings on the basis of which actual execution of the Work is to proceed, shall be furnished from time to time during the progress of the work. The Contractor shall be deemed to have gone through the drawings supplied to him thoroughly and carefully and in conjunction with all other connected drawings and bring to the notice of the Engineer-In- Charge discrepancies if any, therein before actually carrying out the Work.

5.4.6.3. Copies of all detailed working drawings relating to the works shall be kept at the Contractor's office on the Site and shall be made available to the Engineer-In-Charge / Owner at all times during the Contract Period. The drawings and other documents issued by the Owner shall be returned to the Owner on issue of the Final Completion Certificate.

5.4.6.4. In the event of ambiguities, discrepancies, and contradictions between the BOQ, the Drawings and /or Specifications, the Contractor shall immediately notify the EIC. The Architect and / or Engineering Consultant shall explain the same and the EIC shall at their sole discretion, determine which of the requirements govern and / or clarify any such ambiguity or discrepancy and the Contractor shall comply with such determination.

5.4.6.5. All the intellectual properties in the drawings supplied by the Owner are deemed to be the property of the Owner at all times. The Contractor agrees both on behalf of himself and the Contractor's Personnel, whether during the Contract Period or after the completion of the Works, not to divulge or use, except for the purposes of the Contract, the Drawings supplied or any information contained in such drawings.

5.4.7. DRAWINGS TO BE SUPPLIED BY THE CONTRACTOR (SHOP DRAWING)

5.4.7.1. Where drawings / data are to be furnished by the Contractor, they shall be furnished within the specified time and as directed by Engineer-In-Charge.

5.4.7.2. Where approval of drawings before manufacture / construction / fabrication has been specified, it shall be Contractor's responsibility to submit these drawings to the Owner / Engineer-In-Charge and seek approval for the same before proceeding with the Works or commencing construction, as the case may be. Any changes that may be directed by the Owner / Engineer- In-Charge to the drawings during the execution of the Work, shall have to be carried out by the Contractor to the satisfaction of Engineer-In-Charge at no extra / additional cost.

5.4.8. CONTRACTOR'S DESIGNS & MANUFACTURER'S CATALOGUES

5.4.8.1. For the items of Work which are executed to the Contractor's Drawings and Specifications, the Contractor shall allow in their Tender for providing the Owner with 3 copies of all designs, Drawings and Specifications, general arrangement drawings and shop drawings which he needs to submit.

5.4.8.2. The Contractor shall supply 3 copies of all manufacturer's catalogues, brochures of all equipment and proprietary articles specified, or which the Contractor proposes to use for the execution of the Work, for the approval by the EIC / Architect / Engineering Consultant, as soon as is reasonably practicable.

5.4.9. CONTRACTOR TO PREPARE 'AS BUILT' DRAWINGS AND DOCUMENTATION

The Contractor shall during the course of execution of the Works, prepare and keep updated a complete set of drawings to show each and every change in the Works executed as against the Specifications and Drawings. The EIC / Architect / Engineering Consultant and the Contractor shall countermand changes recorded. Three copies of "as built" drawings, folded and bound to A4 size shall be supplied to the EIC / Architect / Engineering Consultant within 30 days of the Virtual Completion. Four sets of these drawings on compact disks (CDs) shall also be supplied on 'AutoCAD Latest Release' at no extra cost to the Owner. The Contractor shall also provide adequate training to the Owner's operations and maintenance staff at the time of handing over of their Works and submit a manual in a format prescribed by the Owner with respect to such Works ("**Handing Over Manual**"), which shall be supplied to the Contractor in due course.

5.4.10. SETTING OUT WORKS

5.4.10.1. The Contractor shall provide, fix and be responsible for the maintenance of all stakes, templates, level marks, profiles and other similar things and shall take all necessary precautions to prevent their removal or disturbance and shall be responsible for the consequence of such removal or disturbance should the same take place and for their efficient and timely reinstatement. The Contractor shall also be responsible for the maintenance of all existing survey marks, boundary marks, distance marks and centre line marks, either existing or supplied and fixed by the Contractor. These Works shall be set out to the satisfaction of the Engineer-In-Charge. The approval thereof or joining with the Contractor by the Engineer-In-Charge in setting out the Work shall not relieve the Contractor of any of his responsibilities.

5.4.10.2. Before beginning the Works set out in Clause 10.1 above, the Contractor shall at his own cost, provide all necessary reference, grids and level posts, pegs, bamboo's, flags, ranging rods, strings and other materials for proper layout of the work in accordance with the scheme for bearing marks acceptable to the Engineer-In-Charge. The centre, longitudinal or face lines and cross lines shall be marked by means of small masonry pillars. Each pillar shall have distinct mark at the centre to enable theodolite to be set over it. No Work shall be started until all these points are checked and approved by the Engineer-In-Charge in writing but such approval shall not relieve the Contractor of any of his responsibilities. The Contractor shall also provide all labour, material and other facilities, as necessary, for the proper checking of layout and inspection of the points during construction.

5.4.10.3. Pillars bearing geodetic marks located at the sites of units of Works under construction should be protected and fenced by the Contractor. The Contractor shall take precautions to ensure that the lines, points, bench marks fixed are not disturbed and shall make good any damage to these at his own cost.

5.4.10.4. On completion of Works, the Contractor must submit the geodetic documents according to which the Work was carried out.

The Contractor shall be entirely and exclusively responsible for the horizontal and vertical alignment, the levels and correctness of every part of the Work and shall rectify effectually any errors or imperfections therein. Such rectifications shall be carried out by the Contractor, at his own cost, as and when instructions are issued to that effect by the Engineer-In-Charge.

5.4.11. PROGRAMME EVALUATION AND REVIEW

5.4.11.1. Network based integrated Time Schedule shall be submitted by the Contractor. The Time Schedule shall include details of mobilization of resources, materials, equipment and labour. After award of Contract, the EIC / Architect / Engineering Consultant may require the Contractor to expand the information given in the Master Construction Programme until it is suitable for the effective review of progress during the execution of the works. The critical path shall be determined. It is the Contractor's obligation to ensure that such a programme, duly approved by the EIC is available within 15 days of placement of order.

5.4.11.2. The Contractor shall, every fortnight, review and update this programme and furnish for the information of the EIC, in writing, details of the Contractor's arrangements for executing the Works, materials procured, erected, balance at Site, and expected deliveries during the next fortnight; skilled / unskilled labour, foremen, supervisors working at Site and steps proposed for speeding up progress of Work.

5.4.11.3. During the updating of the Programme Schedule, if it is found that any or some task has not been completed in specified target date in the schedule, without changing the major mile stone date, Contractor shall adjust such back logs in the updated schedule. Small changes in Drawings, revisions in Drawings, issuance of any sketch with detailing, small and minor change in decision, small and minor holds, occasional non availability of some work fronts, ordering of Work in piece meal manner, minor delay in handing over site of work, occasional delay in Owner’s supply of materials or minor shortage of Owner’s supply material shall not constitute sufficient ground for doing any changes in the Programme Schedule unless the delay, in the opinion of the Engineer-In-Charge, causes actual impediment in Work for a considerable period of time. It shall be clearly understood under the Contract that the Contractor shall endeavour their best to make good the delay and shall do all as per the requirement and satisfaction of the Owner to proceed with the Work by covering up such delay. For doing so, no claim or compensation shall be payable to Contractor.

5.4.11.4. If at anytime it should appear to the EIC or the Architect / Engineering Consultant that the progress of the Works does not conform to the Programme Schedule, the Contractor shall furnish a revised programme and take such steps at their cost, as are necessary to expedite progress and ensure completion of the Works within the completion period or extended date of completion, provided that any extension of time given by the EIC on account of revised programme shall not affect the penalty payable pursuant to the provisions of the Contract.

5.4.11.5. Approval by the EIC of such programmes or the furnishing of such particulars shall not relieve the Contractor of any of their duties or responsibilities under the Contract.

5.4.11.6. The Contractor shall be called upon to attend co-ordination meetings with the Owner / EIC / Architect / Consultant/ Engineering Consultant and other contractors and shall fully co-operate with such persons and agencies involved in these discussions. The Contractor shall take notes of the discussions during the meeting and shall strictly adhere to the decisions of the EIC in performing the works.

Materials may be supplied free or on recovery basis at basic rate mentioned in the Tender and Special Conditions of Contract, in detail.

5.4.12. OWNERS SUPPLY MATERIALS

5.4.12.1. Immediately prior to delivery, Contractor shall undertake detailed inspection of the materials being supplied to him and shall immediately give notice to the Owner of any shortage, defect or default in the materials. Unless otherwise agreed by Parties, Owner shall, as soon as reasonably practicable, rectify any such shortage, defect or default. Contractor shall be responsible for taking delivery of such materials and arrange for loading & unloading, transport at Site.

5.4.12.2. Upon receipt of materials by Contractor, such materials shall come under the care, custody and control of Contractor and all risk therein after shall pass to the Contractor. Contractor shall be responsible for maintaining such material in good condition. If any such material is damaged or lost at any time for any reason after delivery to Contractor, Contractor shall replace such material at its own cost in accordance with directions issued by the Engineer-In- Charge.

5.4.12.3. Owner shall not be liable for any delay in supply or non-supply of any materials if such failure or delay is due to any circumstances beyond the reasonable control of the Owner including due to natural calamities, act of enemies, any regulations imposed by Governmental Authorities, transport and procurement difficulties. Contractor shall not be entitled to claim any extension of targets set out in the Programme Schedule or any compensation or loss suffered by it on account of such delay or non-supply.

5.4.12.4. Materials shall be used by Contractor solely for performance of its obligations under the Contract. All materials so provided by Owner to Contractor shall remain the absolute property of the Owner and shall not be removed from Site on any account whatsoever and Engineer-In-Charge shall be entitled at any and all times to undertake inspection in this regard.

5.4.12.5. Contractor shall be responsible, at its sole cost, for storage and safe custody of materials at Site after issuance thereof by Owner. Contractor shall construct suitable godowns conforming to relevant IS (Indian Standard) Codes at Site for storing such materials and ensuring their safety against damage by rain, dampness, fire, theft and so on. Contractor shall employ necessary personnel for safe keeping of such material.

5.4.12.6. Contractor shall furnish to the Engineer-In-Charge sixty (60) days in advance, a statement setting out the (i) quantities of materials required by Contractor to complete the Work; and (ii) the time when such supplies shall be required by Contractor for due and proper performance of Work, thereby enabling the Engineer-In-Charge to make necessary arrangements for procurement and supply of the materials. Contractor shall be paid a mutually agreed percentage of the material cost as co-ordination charges to cover for handling, storage expenses, overheads and profit.

5.4.12.7. Contractor shall on a daily basis maintain accounts in respect of the materials issued by Owner indicating the daily receipt, consumption and closing balance in hand. Such account shall be maintained in a manner approved by the Engineer-In-Charge along with all connected documents including requisitions, issues, and so on and shall be available for inspection at all times in Contractor's office at Site.

5.4.12.8. Contractor shall ensure judicious and economical use of materials provided by Owner and shall ensure that only required quantities of such materials are procured from the Engineer-In-Charge.

5.4.12.9. Materials / equipment supplied to Contractor by Owner shall not be utilized for any purpose(s) other than that issued for.

5.4.12.10. Contractor shall arrange for timely delivery of all materials required to be supplied by it for completion of Work in accordance with the Programme Schedule. If, however, in the opinion of the Engineer-In-Charge, completion of Work and / or achievement of milestone dates set out in the Programme Schedule is delayed or likely to be delayed due to Contractor's inability to arrange for supplies of such materials, Engineer-In-Charge may (without having the obligation to) issue such materials if available with Owner or arrange for procurement of such materials from the market or elsewhere; and the Contractor shall be bound to procure such materials at the rates and on the terms agreed to by the Engineer-In-Charge. Provided, however, Contractor shall not be relieved from its responsibility of procuring supply of materials in part or in whole and the Contractor shall not be entitled to any extension of Progress Schedule or increase in the Total Contract Value.

5.4.12.11. The Contractor shall obtain prior approval from the EIC / Consultant / Architect with respect to the quality of the material(s) to be used in the Works.

5.4.12.12. Owner may, as per their discretion, instruct the Contractor to supply materials which are supposed to be supplied by the Owner as per the scope defined in the Contract. In such case, Owner shall issue a notice ordering to supply these materials in advance, within such reasonable period as may be determined by the EIC. Rate of such material shall be finalised by the EIC along with Contractor and supplying vendors. When such materials are to be supplied on recovery basis as per contract on fixed basic rate, rate deference with respect to original purchase invoices shall be paid extra or deducted. In case of free supply material, the full supply amount against purchase invoices shall be paid to the Contractor along with agreed [OHP] towards co-ordination, storage and safe custody of the materials. However, the Contractor shall have no claim other than above, due to supply of such materials for any reason whatsoever.

5.4.13. CONDITIONS FOR ISSUE OF MATERIALS

5.4.13.1. Materials specified as to be issued by the Owner shall be supplied to the Contractor by the Owner at a designated point at the Site. It shall be the responsibility of the Contractor to take delivery of the materials and arrange for its loading, transport and unloading at the Site at his own cost. The materials shall be issued between the working hours and as per the rules of the Owner as framed from time to time.

5.4.13.2. The Contractor shall construct suitable godowns, where necessary, confirming to relevant IS Codes at the Site of Work for storing the materials safely against damage by rain, dampness, fire, theft, etc. He shall also employ necessary watch and ward establishment for the purpose.

5.4.14. SCRAP AND WASTAGE AND EXCESS MATERIALS

5.4.14.1. On completion of the Work, the Contractor shall submit the "Materials Appropriation Statement" for all the materials issued by the Owner.

5.4.14.2. Every quarter, the Contractor shall submit an account for all the materials issued by the Owner in the proforma approved by Engineer-In-Charge.

5.4.14.3. All steel and other materials shall be issued in available length / size and no claim for extra payment or extra wastage beyond specified limit on account of issue of non-standard lengths / sizes shall be entertained.

5.4.14.4. Percentage of allowance for scrap and wastage are mentioned in detail in Tender and instruction form and Special Conditions of Contract. Wastage beyond specified limit shall attract penal recovery.

5.4.15. MATERIALS OBTAINED FROM DISMANTLING

If the Contractor, in the course of execution of the Work, is called upon to dismantle any part of the Works for reasons other than those stipulated in Clauses under heading

"Action where no specification is issued" and "Assistance to the engineer" hereunder, the materials utilized towards such dismantling of Works shall be considered as the Owner's property and shall be disposed of to the best advantage of the Owner.

5.4.16. ARTICLES OF VALUE FOUND

All gold, silver and other minerals of any description and all precious stones, coins, treasure, relics, antiquities and other similar things which shall be found in, under or upon the Site, shall be the property of the Owner and the Contractor shall duly preserve the same to the satisfaction of the Engineer-In-Charge and shall from time to time deliver the same to such person or persons indicated by the Owner.

5.4.17. Discrepancies between Instructions

Should any discrepancy occur between the various instructions furnished to the Contractor, or the Contractor's Personnel or any ambiguity arises as to the meaning of any such instructions or should there be any misunderstanding between the Contractor's Personnel and the Engineer-In-Charge's staff, the Contractor shall refer the matter immediately in writing to the Engineer-In-Charge, whose decision thereon shall be final and conclusive and no claim for losses alleged to have been caused by such discrepancies between instructions, doubts, or misunderstanding shall in any event be admissible.

5.4.18. ACTION WHERE NO SPECIFICATION IS ISSUED

In case of any Work for which there is no such specification supplied by the Owner as is mentioned in the Tender, such Work shall be carried out in accordance with relevant IS specifications and if the IS specifications do not cover the same, the Work should be carried out as per Good Industry Practise and standard engineering practice, subject to the approval of the Engineer-In-Charge.

5.4.19. INSPECTION OF WORKS

5.4.19.1. The Contractor shall submit his detailed Quality Control & Assurance ("QC") system plan with the Instruction Test Plan ("ITP") (collectively, the "Quality Plan") to the EIC. The Quality Plan should indicate Contractor's organizational approach for QA/QC of construction activities ranging from incoming material surveillance to finally handing over the complete system to the Owner.

The Contractor's ITP for all construction activities shall be approved by the EIC. The indicative ITP should include: -

1. Details of stages of inspection / tests by Contractor's Representatives.

2. Stage inspection to be offered to the Owner for various stages including review, random witness and witness, hold.

3. Documentation on approved formats shall be prepared by the Contractor and submitted to the Owner for records / approval.

   The Contractor shall also submit to the Owner his QA/QC organisation, mentioned therein specific QA/QC activities assigned against each inspection personnel. The Owner reserves the right to interview Contractor's Personnel and reject if he/she is found not qualified / fit for the job he is assigned to.

5.4.19.2. The Engineer-In-Charge shall have full power and authority to inspect the Works at any time wherever in progress either on the Site or at the Contractor's premises / workshops wherever situated, premises / workshops of any Contractor's Personnel or where materials are being or are to be supplied; and the Contractor shall afford or procure for the Engineer-In-Charge every facility and assistance to carry out such inspection.

The Contractor shall, at all time during the usual working hours and at all other times at which reasonable notice of the intention of the Engineer-In-Charge or his representative to inspect the Works shall have been given to the Contractor, either himself be present to receive orders and instructions, or have a responsible representative duly accredited in writing present for the purpose. Orders given to the Contractor's Representative shall be considered to have the same force as if they had been given to the Contractor himself. The Contractor shall give not less then seven (7) days' notice in writing to the Engineer-In-Charge before disposing or otherwise making unavailable for inspection and measurement any Work in order that the same may be inspected and measured. In the event of breach of above, the same shall be retrieved at Contractor's expense for carrying out such measurement or inspection.

5.4.19.3. No material shall be dispatched from the Contractor's stores before obtaining the approval in writing of the Engineer-In-Charge. However, such approval shall not be unreasonable withheld or delayed.

5.4.19.4. The Contractor is to provide at all times during the progress of the work and maintenance period, proper means of access including by way of ladders, gangways and the necessary attendance to move and adopt, as directed for inspection or measurement of the Works by the Engineer-In-Charge.

5.4.19.5. The Contractor shall maintain a Site Order Book on which the Owner or his representative shall record instructions, a copy of which shall be handed over periodically to the Owner. The Contractor shall promptly comply with such instructions.

5.4.20. ASSISTANCE TO THE ENGINEER

The Contractor shall make available to the Engineer-In-Charge, free of cost, all necessary instruments and assistance in checking of, setting out of Works and in the

checking of any Works made by the Contractor for the purpose of setting out and taking measurements of Works.

5.4.21. TESTS FOR QUALITY OF WORKS

All workmanship shall be of the respective kinds described in the Contract Documents and in accordance with the instructions of the Engineer-In-Charge and shall be subjected from time to time to such test at Contractor's cost as the Engineer-In-Charge may direct at the place of manufacture or fabrication or on the Site or at all or any such places. The Contractor shall provide assistance, instruments, labour and materials as are normally required for examining, measuring and testing any workmanship, as may be selected and required by the Engineer-In- Charge.

5.4.21.1. All the tests that shall be necessary in connection with the execution of the Works as decided by the Engineer-In Charge shall be carried out at the field-testing laboratory of the Contractor. In case of non-availability of testing facility for a particular test with the Contractor, the required test shall be carried out at a laboratory approved by the EIC. The costs of all such tests shall be borne by the Contractor

5.4.21.2. If any tests are required to be carried out in connection with the work or materials or workmanship not supplied by the Contractor, such tests shall be carried out by the Contractor as per the instructions of Engineer-In-Charge and cost of such tests shall be reimbursed to the Contractor.

5.4.21.3. The cost of making any test shall be borne by the Contractor if the test is –

a) clearly intended by or provided for in the Contract, or

b) particularised in the Contract (in 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 fulfil).

5.4.22. SAMPLES

The Contractor shall furnish to the Engineer-In-Charge, for approval when requested or if required by the Specifications, adequate samples of all materials and finishes to be used in the Work. Such samples shall be submitted before the Work is commenced and in ample time to permit test and examinations thereof. All materials furnished and finishes applied in actual Work shall be fully equal to the approved samples.

5.4.23. ACTION AND COMPENSATION IN CASE OF BAD WORK

If it shall appear to the Engineer-In-Charge that any Work has been executed with unsound, imperfect or unskilled workmanship, or with materials of any inferior description, or that any materials or articles provided by the Contractor for the execution of the Work are unsound, or of a quality inferior to that contracted for, or

otherwise not in accordance with the Good Industry Practise and the Contract, the Contractor shall on demand in writing from the Engineer-In-Charge or his authorised representative specifying the work, materials or articles complained of, notwithstanding that the same may have been inadvertently passed, certified and paid for, forthwith rectify or remove and reconstruct the Work so specified and provide other proper and suitable materials or articles at his own expense; and in the event of failure to do so within a period to be specified by the Engineer-In-Charge in his demand aforesaid, the Contractor shall be liable to pay compensation at the rate of one percent (1%) of the estimated cost of such Work, for every week while his failure to do so shall continue and in the case of any such failure, the Engineer-In-Charge may on expiry of notice period rectify or remove and re-execute such Work or remove and replace with others, the materials or articles complained of, as the case may be, at the risk and expense in all respects of the Contractor. If the Owner so requests, the tests of rejected materials or plant shall be made or repeated under the same terms and conditions. All costs incurred shall be recoverable from the Contractor by the Owner and may be deducted from any of the monies due to or become due to the Contractor. The decision of the Engineer-In-Charge as to any question arising under this Clause shall be final and conclusive.

5.4.24. SUSPENSION OF WORKS

5.4.24.1. The Owner may at any time suspend the Work or any portion thereof for a period of not more than thirty (30) days by a notice in writing to Contractor. The Contractor shall, during such suspension, protect and secure the Works at the Site at all times and shall resume the suspended work on such date as may be fixed by the Engineer-In-Charge. The Contractor may be allowed an extension of the Time Schedule, directly attributable to any such suspension and if considered necessary by the Owner. Further, the Contractor shall resume the suspended work as expeditiously as possible after receipt of withdrawal of suspension order by the Owner as the case may be.

5.4.24.2. The extra cost incurred by the Contractor on account of paying idle charges of labour and equipment during such suspension of work, shall be borne by the Owner unless suspension is:

(i) otherwise provided for in the Contract; or

(ii) necessary by reason of some default or of breach of the Contract on the part of the Contractor; or

(iii) due to Force Majeure; or

(iv) necessary for the execution and safety of the Works and such necessity does not arise from any act or default by the Owner and / or the Engineer-In-Charge

Provided that the Contractor shall not be entitled to recover any such extra cost unless the Contractor gives a written notice of his intention to claim by reason of

such suspension to the Owner within fourteen (14) days of receipt of written order of the Owner.

5.4.24.3. If such suspension continues for a period of more than thirty (30) days, at the end of such period the Contractor may, by a seven (7) days prior written notice to the Owner and / or Engineer-In-Charge, terminate the Contract and recover from Owner payment as may be due and payable under the Contract for Works that have been executed. No extra claim in any form due to such suspension or termination shall be payable.

5.4.25. APPOINTMENT OF OTHER CONTRACTOR(S) AND AGENCIES

In the event of termination for Contractor's default or termination due to suspension, the Owner reserves the rights to complete the Works and, for which, be entitled to appoint other contractor(s) and agencies. The expenses incurred for the same shall be recovered from the Contractor or deducted from the amounts due and payable to the Contractor.

5.4.26. OWNER MAY DO PART WORK.

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

5.4.27. POSSESSION PRIOR TO COMPLETION

The Owner shall have the right to take possession of or use any completed or partially completed Work or part of the Work. Such possession or use shall not be deemed to be an acceptance of any Work completed in accordance with the Contract.

5.4.28. DEFECTS LIABILITY PERIOD:

5.4.28.1. The Contractor warrants and guarantees that it shall perform and furnish the Works under this Contract with the degree of high professional skill, Good Industry Practise, sound engineering principles and practices and good judgement, normally exercised by recognized professional firms providing works of a similar nature.

5.4.28.2. The Contractor shall guarantee and maintain the Works (including all installations) for a period of minimum 12 (twelve) months or such other extended period as mentioned in Purchase Order or in Special Conditions of Contract from the date of issue of the Virtual Completion Certificate. Any damage or defect that may arise or lie undiscovered due to its own construction or faulty materials or workmanship, or that of his Sub-Contractors at the time of issue of the Virtual Completion Certificate, connected in any way with the equipment or materials supplied by him or in the workmanship, shall be rectified or replaced by the Contractor at his own expense as deemed necessary by the Engineer-In-Charge or in default, the Engineer- in-Charge may cause the same to be made good by other workmen and deduct expenses (of which the certificate of Engineer-In-Charge shall be final) from any sums that may be then or at any time thereafter, become due to the Contractor or from his retention money or the proceeds of sale thereof, or of a sufficient portion thereof.

5.4.28.3. If the Contractor feels that any variation in work or in quality of materials or proportions would be necessary to fulfil the guarantees called for, he shall bring this to the notice of the Engineer-In-Charge in writing.

5.4.29. INDEMNITY

5.4.29.1. The Contractor shall at all times indemnify the Owner against all claims, damages or losses that be incurred by the Owner pursuant to a breach by the Contractor or the Contractor's Personnel in accordance with the provisions of any Applicable Law including Payment of Wages Act, 1938, Minimum Wages Act, 1948, Owner's Liability Act, 1938, Workmen's Compensation Act 1923, Fatal Accidents Act, Apprentices Act 1961, Industrial Disputes Act, 1947 and Contract Labour (Regulation & Abolition) Act, 1970.

5.4.29.2. The Contractor shall indemnify, defend and hold harmless the Owner and their subsidiaries, affiliates and the officers, agents, employees, successors, assigns and / or other authorized representatives of all the foregoing from and against any and all suits, actions, legal or administrative proceedings, damages, liabilities, interest, attorney's fees, costs, expenses and losses of whatsoever kind or nature in connection with or incidental to the performance of this Contract, whether arising before or after completion of the Works hereunder and in any manner directly or indirectly caused, occasioned, or contributed to in whole or in part, or claimed to be caused, occasioned or contributed to in whole or in part, by reason of any act or omission for which the Contractor or anyone acting under its direction or control.

5.4.29.3. The foregoing shall include, but not be limited to, indemnifying and keeping indemnified towards the cost or claims arising out of the following:

1. Property damage and / or injury to and / or death of any person, including employees of Owner and / or Contractor or the Contractor's Personnel; and

2. The breach by Contractor of any representation, warranty, covenant, or performance obligation of this Contract.

3. The negligence or wilful misconduct of the Contractor

5.4.29.4. Contractor's aforesaid release, indemnity and hold harmless obligations, or portions or applications thereof, shall apply even in the event of the fault or negligence, whether active or passive, or strict liability of the parties released, indemnified or held harmless to the fullest extent permitted by law, but in no event shall they apply to liability caused by the wilful misconduct or sole negligence of the party released, indemnified or held harmless. Such indemnity shall be subject to mitigation by Owner of his loss and the provision of reasonable notice to Contractor before concluding any settlement with a third party.

5.4.30. CARE OF WORKS

From the commencement to completion of the Works, the Contractor shall take full responsibility for the care for all Works including all temporary works and in case any damages, loss shall happen to the Works or to any part thereof or to any temporary works from any cause whatsoever, shall at his own cost, repair and make good the same so that at completion of the Work, the same shall be in good order and in conformity in every respects with the requirements of the Contract and the Engineer-In-Charge's instructions.

5.4.31. REMOVAL OF DEFECTS PRIOR TO TAKING OVER

5.4.31.1. If at any time before taking over of the Works by the Owner, the Engineer-In-Charge shall on inspection identify that any work done or materials used by the Contractor or any of the Contractor's Personnel is defective or not in accordance with the Contract, or that the Works or any portion thereof are defective, or do not fulfil the requirements of Contract (all such matters being hereinafter, called "" in this Clause), the Engineer-In-Charge shall notify the Contractor in writing of the existence or occurrence any such Defects.

5.4.31.2. The Contractor being responsible for the complete supervision of the Project, shall within one (1) month of receipt of the notice from the Engineer-In-Charge of his decision, promptly remove, replace, re-execute, rectify and make good all such Defects in the Works to the satisfaction of the Engineer-In-Charge. The Contractor agrees and acknowledges that all such Work shall be done at his own costs, expenses and consequences.

5.4.31.3. In the event the Contractor shall fail to do so within the period as specified above, the Owner may arrange for the same to be done by some other person or agency and the agreed cost thereof, supported by all evidence and duly certified by the Engineer-In-Charge (whose decision on such cost shall be final and binding on the Contractor), shall be recoverable from the Contractor by the Owner or deducted from the Contract Price if the same is not paid by the Contractor to the Owner.

5.4.32. VIRTUAL COMPLETION AND TAKING OVER

5.4.32.1. For the purpose of this Clause, Virtual Completion shall mean the completion of the following activities to the satisfaction of the Owner in relation to the Project:

(i) Completion of the Works in accordance with the Contract (except in minor respects that do not affect their use for the purpose for which they are intended and except for maintenance thereof);

(ii) The successful testing and commissioning of all the Works in accordance with the standard testing procedures prescribed under the Contract;

(iii) Liquidation of all the Defects as specified in the Clause under heading "Removal of Defects Prior to Taking Over" above;

(iv) Removal of all the Contractor's Personnel and relevant offices located on Site (except such Contractor's Personnel engaged for completing the pending works indicated under sub-paragraph (i) above) and the clearing of the Site to the satisfaction of the Engineer-In-Charge; and

(v) Full compliance of all the requirements as may be laid down as terms and conditions in the Virtual Completion Certificate.

5.4.32.2. On happening of all the events specified hereinabove and the Contractor fulfilling his obligations as specified in Clause 31 of Section IV, the Contractor shall be eligible to make an application in the manner as provided by the Owner along with the documents as specified herein below in Clause 32.6, for issuance of the Virtual Completion Certificate by the Owner and also for separate Virtual Completion Certificate(s) in respect of each such portion(s) or section(s) of the Works regarded to be virtually complete.

5.4.32.3. The Engineer-In-Charge shall, within one (1) month of receipt of such application and the Completion Documents (as set out in Clause 32.6), verify the same and, on being satisfied that Works have been completed in accordance with and as set out in the Specifications, Drawings, and the Contract Documents, issue the Virtual Completion Certificate. However, if some minor work remains to be done or some deficiency in Works requires correction by the Contractor and provided such minor and / or deficient work does not affect the operation of the Works or initiating and carrying on the activities as contemplated by the Owner on the Site and / or readiness of the Project and / or the Site, the Works shall be accepted and taken over by the Owner. On issuance of the Virtual Completion Certificate, the Contractor is eligible to present his Final Bill for the Works executed by him under the terms of Contract.

5.4.32.4. The Virtual Completion Certificate so issued shall certify the date on which the Works have been so completed, and taken over by the Owner. The Certificate shall also mention the Defects or deficiencies or outstanding Work, if any, to be rectified or completed by the Contractor, as the case may be, before the issuance of the Final Completion Certificate by the Owner.

5.4.32.5. In the event the Works have been divided into various portions or sections in the Contract, the Owner shall be entitled to take over any such portion(s) or section(s) before the other portion(s) or section(s) are ready and complete. On such partial taking over, the Engineer-In-Charge shall issue a Virtual Completion Certificate with regard to only such portion(s) or section(s) as may be taken over by the Owner. Such taking over by the Owner, before the Contract is completed, shall in no way relieve the Contractor of his obligations and duties under this Contract to complete the Works as required and shall not constitute an acceptance of the Works, or any part thereof, unless so stated in writing by the EIC / Project Manager.

5.4.33. COMPLETION DOCUMENTS

The application to be submitted by the Contractor for the Virtual Completion Certificate shall be accompanied with the following documents:

(i) The technical documents according to which the Works were carried out.

(ii) Three sets of construction drawings showing therein the modification and corrections made during the course of execution signed by the Engineer-In-Charge.

(iii) Completion certificate for ‘embedded’ and ‘covered’ up Works.

(iv) Certificates of final levels as set out for various Works.

(vi) Certificates of tests performed for various Works.

(vii) Material appropriation statement for the materials issued by the Owner for the Works duly supported by necessary documents.

(viii) Certificate of compliance with statues, laws, rules, orders prevailing from time to time during construction period and applicable to the Contractor.

(ix) Certificate for recoveries / deduction from Engineer-in-Charge.

(x) Original copies of guarantees of the relevant Contractor's Personnel (or the Contractor) for specialised Work including water proofing work, anti-termite work.

5.4.34. DEFECTS AFTER VIRTUAL COMPLETION AND TAKING OVER

5.4.34.1. In order to obtain the Final Certificate, as specified herein below, from the Owner, the Contractor shall within one (1) month of being notified by the Engineer-In-Charge, make good with all possible speed, any defect arising in the Works or from the materials, tools, plants and equipment supplied by the Contractor, or any defect in the workmanship or any act or omission of the Contractor or its Sub-Contractors or workmen as may have been noticed or developed, after the Works or any portion(s) or section(s) of the Works have been taken over by the Owner.

5.4.34.2. If any such defect be not remedied within the time specified hereinabove, the Owner may arrange for the same to be done by some other person or agency and the agreed cost thereof supported by all evidence and duly certified by the Engineer-In-Charge (whose decision on such cost shall be final and binding on the Contractor) shall be recoverable from the Contractor by the Owner or deducted from the Final Bill if the same is not paid by the Contractor to the Owner.

5.4.34.3. If any defect, shrinkage or other faults in the Works appears at any time prior to the end of the

Defects Liability Period, the Owner may instruct the Contractor to search for the cause thereof. If such defect, shrinkage or other fault is one for which the Contractor is liable, the cost of the work carried out in searching as aforesaid shall be borne by the Contractor and he shall in such case remedy such defects, shrinkage, damages for other works due to search or other fault at his cost.

5.4.35. FINAL COMPLETION CERTIFICATE

Upon rectification of all the defects as specified in Clause under heading "Defects after Virtual Completion and Taking Over" hereinabove and on expiry of the Defects Liability Period and subject to the Engineer-In-Charge being satisfied that the Works have been duly maintained by the Contractor during monsoon or such Defects Liability Period,

and that the Contractor has in all respect duly made up any subsidence and performed all his obligations under the Contract, the Engineer-In-Charge shall (without prejudice to the rights of the Owner to retain the provisions of relevant Clause hereof) give a certificate herein referred to as the Final Completion Certificate to that effect. The Owner may issue the Final Completion Certificate only after the Contractor furnishes all relevant 'As Built' Drawings along with product catalogues. Notwithstanding any taking over of the Site and occupying and using the Works or any part thereof by the Owner, the Contractor shall not be considered to have fulfilled the whole of his obligations under the Contract until such Final Completion Certificate has been issued by the Engineer-In-Charge.

SUB-SECTION- V

5.5. CERTIFICATES AND PAYMENTS

5.5.1. SCHEDULE OF RATES AND PAYMENTS

5.5.1.1. CONTRACTOR'S REMUNERATION

The price to be paid by Owner to the Contractor for the whole of the Work to be done and for the performance of all the obligations undertaken by the Contractor under the Contract Documents, shall be ascertained by application of Schedule of Rates (the inclusive nature of which is more particularly defined by way of application but not of limitation, with the succeeding Sub-Clause of this Clause) and payment to be made accordingly for the Work actually executed and approved by the Engineer-In-Charge. The sum so ascertained shall (excepting only as and to the extent expressly provided herein) constitute the sole and inclusive remuneration of the Contractor under the Contract and no further or other payments whatsoever shall be or become due or payable to the Contractor under the Contract.

5.5.1.2. SCHEDULE OF RATES TO BE INCLUSIVE

The prices / rates mentioned in the Contract shall not be subject to any change whatsoever till the issue of Final Certificate and shall not be subject to escalation. Schedule of Rates shall be deemed to include and cover all costs, expenses and liabilities of every description and all risks of every kind to be taken in executing, completing and handing over the Work to the Owner by the Contractor. The Contractor shall be deemed to have known the nature, scope, design, type magnitude and the extent of the Works and materials required for the Works, based on the preliminary drawings issued with the Contract Documents. He shall make such provision in the Schedule of Rates as he may consider necessary to cover the cost of such items of Work and materials as may be reasonable and necessary to complete the Works. The opinion of the Engineer-In-Charge as to the items of Work which are necessary and reasonable for completion of Work shall be final and binding on the Contractor, although the same may not be shown on or described specifically in Contract Documents.

Generality of this present provision shall not be deemed to cut down or limited in any way because in certain cases, it may and in other cases it may not be expressly stated that the Contractor shall do or perform a work or supply articles or perform services at his own cost or without addition of payment or without extra charge or words to the same effect, or that it may be stated or not stated that the same are included in and covered by the Schedule of Rates.

5.5.1.3. SCHEDULE OF RATES TO COVER PLANTS & MACHINERIES, MATERIALS, LABOUR, ETC.

Wherever applicable, without in any way limiting the provisions of the preceding Sub-Clause, the Schedule of Rates shall be deemed to include and cover the cost of all plants & machineries, temporary work (except as provided for herein), pumps, materials, labour, tools and tackles, insurance, fuel, stores, and appliances to be supplied by the Contractor and all other matters in connection with each item in the Schedule of Rates and the execution of the Works or any portion thereof finished, complete in every respect and maintained as shown or described in the Contract Documents or as may be ordered in writing during the continuance of the Contract.

5.5.1.4. SCHEDULE OF RATES TO COVER ROYALTIES, RENTS AND CLAIMS

The Schedule of Rates shall be deemed to include and cover the cost of all royalties and fees for the articles, and processes, protected by letters, patents or otherwise incorporated in or used in connection with the Works, all royalties and other payments in connection with obtaining materials of whatsoever kind for the Works and shall include an indemnity to the Owner which the Contractor hereby gives against all actions, proceedings, claims, damages, costs and expenses arising from the incorporation in or use on the works of any such articles, processes or materials. Octroi or other municipal or local body charges, if levied on materials, equipment or machineries to be brought to Site for use on Work, shall be borne and paid by the Contractor.

5.5.1.5. RETENTION MOU

Unless otherwise specified, the total retention shall be deducted from each R.A, Bill at the rate mentioned in Purchase Order and Special Conditions of Contract, and shall be released on completion of Defects Liability Period.

5.5.1.6. LIQUIDATED DAMAGES FOR DELAY

If the Contractor fails to comply with the time of completion for the whole of the Works or if applicable, any Section within the relevant time, then the Contractor shall pay the Owner liquidated damages of one percent (1%) per week of the accepted Total Contract Value and limited to a total of ten percent (10%) of the accepted Total Contract Value. These liquidated damages for such default representing the Owner’s genuine pre-estimate of the damages, likely to be suffered by him without reference to actual loss and not as a penalty (which sum shall be the only monies due from the Contractor for such default) for every day which shall elapse between the relevant time for completion and the date stated in a taking-over certificate of the whole of the Works or the relevant section, subject to the applicable limits as stated above.

The Owner may, without prejudice to any other method of recovery, deduct the amount of such damages from any monies due or to become due to the Contractor. The payment or deduction of such damages shall not relieve the Contractor from his obligation to complete the Works, or from any other of his obligations and liabilities under the Contract nor prejudice exercising any other right or remedy of the Owner available under the Contract.

5.5.1.7. TAXES AND DUTIES

5.5.1.7.1 Excise & Customs:

(a) Contractor shall maintain and produce to the Owner on demand, excise and customs duty paying documents in respect of the materials and documents brought to the Site by the Contractor. Applicable duties shall be included in the Contract Price or shall be reimbursed extra as per terms of Purchase Orders.

(b) If any excise duty becomes payable due to non-observance of the conditions of the notifications mentioned above or otherwise, the same shall be the responsibility of the Contractor and shall be paid by the Contractor as award of the Work by the Owner to the Contractor is on principal to principal basis.

(c) Price payable to the Contractor is inclusive of royalty or as per Purchase Order terms if any, payable by the Contractor under any Applicable Law to any Governmental Authority for execution of the Contract.

5.5.1.7.2 Goods and Services Tax

Good and Services Tax payable, if any, for the Contractor's materials and the Work to be carried out by the Contractor shall be borne and paid by the Contractor.

5.5.1.7.3 Octroi

If the Contractor pays any Octroi Duty, the Owner shall reimburse the same to the Contractor.

5.5.1.7.4 General

The Contractor shall also obtain and pay for all permits, or other privileges necessary to complete the Work.

All Taxes and duties or charges due to any Governmental Authority shall be deemed to be included in and covered under Schedule of Rates.

The Contractor shall produce to the Engineer-In-Charge, all original documents relating to Taxes and duties in respect of his materials and Works as and when demanded. A copy of the duty paying documents in respect of Taxes/duties paid by the Contractor shall be furnished to the Engineer-In-Charge at the time of applying for the Final Completion Certificate by the Contractor or as agreed in respective Purchase Orders.

5.5.1.8. SCHEDULE OF RATES TO COVER RISKS OF DELAY

The Schedule of Rates shall be deemed to include and cover the risk of all possibilities of delay and interference with the Contractor's conduct of Work, which occur from any cause including order of the Owner in the exercise of his powers and on account of extension of time granted due to various reasons and for all other possible or probable causes of delay.

5.5.1.9. SCHEDULE OF RATES CANNOT BE ALTERED

For Work under unit rate basis, no alteration shall be allowed in the Schedule of Rates by reason of Works or any part of them being modified, altered, extended, diminished or omitted. The Schedule of Rates are fully inclusive rates which have been fixed by the Contractor and agreed to by the Owner and cannot be altered.

5.5.2. PROCEDURE FOR MEASUREMENT / BILLING OF WORK IN PROGRESS

5.5.2.1. **MEASUREMENTS**

All measurements shall be in metric system. All the Works in progress shall be jointly measured by the representative of the Engineer-In-Charge and the Contractor's Representative progressively. Such measurement shall get recorded in the measurement sheets by the Contractor or his authorised representative and signed in token of acceptance by the Engineer-In-Charge or his authorised representative. For the purpose of taking joint measurements, the Contractor's Representative shall be bound to be present whenever required by the Engineer-In-Charge. If, however he absents, for any reason whatsoever, the measurements shall be taken by the Engineer-In-Charge or his representative, and this shall be deemed to be correct and binding on the Contractor.

5.5.2.2. **BILLING**

(a) The Contractor shall submit on or before the expiry of the first week of each month during the Contract Period (except the first month of the Contract Period), the Running Account Bill of the last 30 (thirty) days work in the format approved by Owner, in triplicate, to the Engineer-In-Charge of the Work giving abstract and detailed measurements for the various items of Work executed during the month. The Contractor shall have to provide monthly issue / return

statement (Reconciliation Statement) for materials with every Running Account Bill.

(b) The Owner shall effect payment as per the payment terms mentioned in the Special Conditions of Contract.

(c) The Reconciliation Statement for Owner's Supply Items (FIMs) to be submitted on mandatory basis with each R.A. Bill, failing which the bill shall summarily be rejected.

(d) The number of payments to be made to the Contractor shall be restricted to one in each month unless otherwise specified in Special Conditions of Contract.

(e) The Owner may by any interim certificate make any correction or modification in any previous certificate which shall have been issued by him and shall have authority, if any Work is not being carried out to his satisfaction, to omit or reduce the value of such Work in any interim certificate and interim certificate shall be considered as only advance against final payment and not as payments for Works actually done, completed and approved and shall not preclude the requiring of bad, unsound, imperfect or unskilled work or materials to be removed and taken away and thereafter reconstructed with proper materials and workmanship.

5.5.2.3. **DISPUTE IN MODE OF MEASUREMENT**

In case of any dispute as to the mode of measurement not covered by the Contract to be adopted for any item of work, the mode of measurement as per latest IS specifications shall be followed.

5.5.2.4. **LUMP SUMS IN TENDER**

For the item in Tender where it includes lump-sum in respect of parts of Work, the Contractor shall be entitled to payment in respect of the items at the same rates as are payable under this Contract for such items, or if the part of the Work in question is not, in the opinion of the Engineer-In-Charge capable of measurement or determination, the Owner may at his discretion pay the lump-sum amount entered in the Tender or a percentage thereof and the certificate in writing of the Engineer-In-Charge shall be final and conclusive against the Contractor with regards to any sum or sums payable to him, under the provisions of this Clause and in accordance with Clause under heading "Billing" above.

5.5.2.5. **PAYMENTS RUNNING ACCOUNT TO BE REGARDED AS ADVANCES**

(a) Even if a certificate is issued by the EIC, all payments made pursuant to R.A. Bills shall be regarded as payments by way of advance against the final payment only and not as payments for work actually done and completed and shall not preclude the enquiring of bad, unsound and imperfect or unskilled

work to be removed and taken away and reconstructed or re-erected or be considered as an admission of the due performance of the contract, or any part thereof, in this respect, or of the accruing of any claim by the Contractor, nor shall it conclude, determine or affect in any way the powers of the Owner under these conditions or any of them as to the final settlement and adjustments of the accounts or otherwise (including by way of deducting or adjusting amounts from subsequent Purchase Orders or Works carried out), or in any other way vary or affect the Contract. The Final Bill shall be submitted by the Contractor within maximum three (3) months from the date of physical completion of the Work, otherwise, the Engineer-In- Charge's certificate of the measurement and of total amount payable for the Work accordingly shall be final and binding on all Parties. Once the Final Bill has been submitted by the Contractor no further additional claims shall be entertained, allowed or considered by the Owner.

(b) Without prejudice to any other remedies or recourse provided under the Contract Documents, in case of any breach by the Contractor (including the Contractor's Personnel) of the terms of the Contract Documents, the Owner shall have the right to withhold any payments under the R.A. Bills and/ or recover the liquidated damages by way of set-off or adjustment from amounts payable under the R.A. Bills.

5.5.2.6. **PAYMENT OF CONTRACTOR'S BILL**

(a) No payment shall be made for Works estimated to cost less than the amount as mentioned in Purchase Order and Special Conditions of Contract, till the whole of the Work shall have been completed and the Virtual Completion Certificate or Final Completion Certificate, as may be applicable is given. But in case of Works estimated to cost more than the amount as mentioned in Purchase Order or Special Conditions of Contract, the Contractor on submitting the bill thereof, be entitled to receive a monthly payment proportionate to the part thereof approved and passed by the Engineer-In-Charge, whose certificate of such approval and passing of the sum so payable shall be final and conclusive against the Contractor. This payment shall be made after making necessary deductions as stipulated elsewhere in the Contract Document including for materials and retention money.

(b) Payment due to the Contractor shall be made by the Owner by Crossed Account Payee Cheque, forwarding the same to registered office or the notified office of the Contractor. In no case shall Owner be responsible if the cheque is mislaid or misappropriated by unauthorised person, persons. In all cases, the Contractor shall present his bill duly pre-receipted on proper revenue stamp.

(c) All payments shall be made in Indian currency.

5.5.2.7. **RECEIPT FOR PAYMENT**

Receipt for payment made on account of Work when executed by a firm, must be signed by person holding due power of attorney in this respect on behalf of the Contractor, except when the Contractor is described in its Tender as a limited company, in which case the receipts must be signed in the name of the company by a person having authorised by the resolution of the Board of Director of the company to give effectual receipt for the company.

5.5.2.8. **CERTIFICATE AND PAYMENTS ON EVIDENCE OF COMPLETION**

Except the Final Completion Certificate as issued by the Owner as per Clause under heading "Final Completion Certificate" of Section IV of the General Conditions of Contract, no other certificates or payments against a certificate or on general account shall be taken to be an admission by the Owner of the due performance of the Contract or any part thereof or of occupancy or validity of any claim by the Contractor.

SUB-SECTION-VI

5.6. TAXES AND INSURANCE

5.6.1. TAXES, DUTIES, OCTROI ETC.

The Contractor agrees to and does hereby accept full and exclusive liability for the payment of any and all Taxes, duties or octroi of whatsoever nature now or hereafter imposed, increased, or modified from time to time in respect of the Works and materials supplied in relation to the Works and all contributions and Taxes towards compensation of employees, insurance and old age pensions or annuities now or hereafter imposed by any Governmental Authority or local authorities or any other body, which are imposed with respect to or covered by the wages, salaries, or other compensations paid to the Persons employed by the Contractor or the Contractor's Personnel, and the Contractor shall be responsible for the compliance with all obligations and restrictions imposed by the applicable labour laws or any other Applicable Law in relation to such personnel of the Contractor and / or the Contractor's Personnel, and the Contractor further agrees to comply, and to secure the compliance of all Sub-Contractors, with all Applicable Laws. Contractor further agrees to defend, indemnify and hold harmless from any liability or penalty which may be imposed by any Governmental Authority by reason of any violation by Contractor or any applicable Contractor's Personnel of such Applicable Law and also from all claims, suits or proceedings that may be brought against the Owner arising under, growing out of, or by reason of the Work provided for by the Contract Documents, by third parties, or by any Governmental Authority. All the applicable Taxes, duties or octroi of whatsoever nature shall be additionally reimbursed or shall be part of Contract Price as specified in the Purchase Orders

5.6.2. INSURANCE

Contractor shall at his own expense carry and maintain insurance with approved insurance companies to the satisfaction of the Owner as follows:-

5.6.3. EMPLOYEES STATE INSURANCE ACT

(a) The Contractor agrees to and does hereby accept full and exclusive liability for the compliance with all obligations imposed by the Employees State Insurance Act, 1948 ("**ESIA**"), and the Contractor further agrees to defend, indemnify and hold Owner harmless from any liability or penalty which may be imposed by any Governmental Authority by reason of any asserted violation by Contractor or the relevant Contractor's Personnel of the Employees' State Insurance Act, 1948, and also from all claims, suits or proceeding that may be brought against the Owner arising under, growing out of or by reasons of the Work provided for by this Contract, whether brought by employees of the Contractor or the Contractor's Personnel, by third parties or by any Governmental Authority.

(b) The Contractor agrees to fill in with the Employee's State Insurance Corporation, the declaration forms and all forms which may be required in respect of the Contractor's or relevant Contractor's Personnel's employees, as revised as per the ESIA and who are employed in the Work provided for or those covered by ESIA from time to time under the Contract. The Contractor shall deduct and secure the agreement of the relevant Contractor's Personnel to deduct the employee's contribution as per the first schedule of the ESIA from wages and affix the employee's contribution cards at wages payment intervals. The Contractor shall remit and secure the agreement of the relevant Contractor's Personnel to remit to the State Bank of India, Employees' State Insurance Corporation's Account, and the Employees Contribution as required under the ESIA. The Contractor agrees to maintain all cards and records as required under the ESIA in respect of employees and payments and the Contractor shall secure the agreement of the Sub-Contractor to maintain such records. Any expenses incurred for the contributions, making contributions or maintaining records shall be to the Contractor's account.

5.6.4. WORKMAN'S COMPENSATION AND OWNER'S LIABILITY INSURANCE

Insurance shall be taken and applicable for all the Contractor's employees engaged in the performance of this Contract. If any of the work is sublet, the Contractor shall require the relevant Contractor's Personnel to provide workman's compensation and owner's liability insurance for the latter's employees. If such employees are not covered under the Contractor's insurance in case the relevant Contractor's Personnel fails to obtain the said insurance, the Contractor has to take insurance on their behalf.

5.6.5. ANY OTHER INSURANCE REQUIRED UNDER LAW OR REGULATIONS OR BY OWNER

Contractor shall also carry and maintain any and all other insurance which he may be required under any Applicable Law from time to time. He shall also carry and maintain any other insurance which may be required by the Owner.

5.6.6. CAR POLICY AND THIRD PARTY INSURANCE (TPI)

(a) Owner shall take property and surrounding property insurance including TPI for Owners Representative and their workmen. All other insurance regarding Contractor's (and the Contractor's Personnel) equipment, machineries their staff and workmen shall be procured by the Contractor. The CAR Policy shall be taken for a sum, which is fifteen percent (15%) higher than the value of Contract, after including the cost of all materials to be supplied by the Owner (either supplied free of cost or at a basic rate). The said CAR Policy shall be valid till the date of completion and extension of time if any. The Owner shall be the co-insured and the Contractor shall deposit the CAR policy with the Owner.

(b) The Contractor shall without, limiting his or the Owner's obligations and the responsibilities insure, in the joint names of the Contractor and the Owner,

against the liabilities for death of or injury to any persons arising out of the performance of the Contract.

(c) The minimum amount of third party policy shall be but not limited to as mentioned in Purchase Order or Special Conditions of Contract.

5.6.7. DAMAGE TO PROPERTY

5.6.7.1. Contractor shall be responsible for making good to the satisfaction of the Owner any loss of and any damage to all structures and properties belonging to the Owner or being executed or procured or being procured by the Owner or of other agencies within the Site, if such loss or damage is due to fault and / or the negligence or wilful acts or omission of the Contractor or the Contractor's Personnel.

5.6.7.2. The Contractor shall indemnify and keep the Owner and Engineer-In-charge harmless of all claims for damage to property other than Owner's property erection under or by reason of this Contract if such claims result from the fault and / or negligence or wilful acts or omissions of the Contractor or the Contractor's Personnel.

SUB-SECTION -VII

5.7. LABOUR LAWS AND SAFETY REGULATIONS

5.7.1. LABOUR LAWS

5.7.1.1. No Person below the age of eighteen years shall be employed on the Work.

5.7.1.2. The Contractor shall not, and shall ensure that none of the relevant Contractor's Personnel, pay less than what is provided under Applicable Law from time to time to the labourers engaged in carrying on the Work.

5.7.1.3. The Contractor shall at his expense comply with all labour laws as per the detail mentioned below.

a. Engagement of Labour and Workmen

i. The Contractor shall make his own arrangements for the engagement of all labour and workmen local or otherwise.

ii. Child labour, as defined under the Child Labour (Prohibition and Regulation) Act, 1986, in any form shall not be engaged and shall not be permitted to work on Site. The Contractor shall ensure that children are confined to the boundary of the hutments and that no children are allowed to wander around work areas of the Site

iii. The Contractor shall strictly comply with all the Applicable Law including labour laws and regulations in force and applicable to the labour employed by him or the Contractor's Personnel including those working on labour-rate basis on the Works.

iv. Disorderly Conduct

The Contractor shall at all times take all reasonable precautions to prevent any unlawful, riotous or disorderly conduct by or against his employees and for the preservation of peace and protection of persons and property in the neighbourhood of the works against the same

v. Observance by Sub-Contractors

The Contractor shall be responsible for observance by his Sub-Contractors of the foregoing provisions. The Contractor shall not sublet any part of the Works without the prior written approval of the Owner

5.7.2. Labour License & other compliances

Before commencement of Works, the Contractor must ensure that he possesses a valid labour licence from the concerned authorities under the Contract Labour (Abolition and Regulation) Act 1970, and furnish a copy of the same to the Engineer-In-Charge. The Contractor shall be responsible and liable for all obligations imposed on him by the provisions and requirements of any Central or State Statute Ordinances or other Laws or any Regulation or by-laws of any local or other duly constituted authority which may be applicable including any amendments or additions during the period of the Contract. The Owner shall not be obliged to keep vigil over the Contractor's observation and compliance with such issues, but if requested by the Owner, he shall show proof of such compliance. The Contractor shall settle, at his own cost, any disputes concerning such matters. The Contractor's compliance and adherence shall include but not limited to the following:

a) The Contract Labour (Regulation & Abolition) Act, 1970
b) Minimum Wages Act, 1948
c) Payment of wages Act, 1936
d) Industrial Disputes Act, 1947
e) Trade union Act, 1926
f) Workmen's Compensation Act, 1923
g) Employee's State Insurance Act, 1948
h) Motor and Transport Workers Act
i) Apprentices Act, 1961
j) The Employees' Provident Fund Act, 1952
k) BOCW 1996
l) Any other Applicable Laws issued by the government from time to time.

It is further clarified that in case the Owner is treated as the principal Owner or like under any of the aforesaid laws or other labour laws, and is required to pay any money to any person including the Government Authorities, the Owner shall be entitled to recover the same from the Contractor. The Contractor also agrees for indemnifying the Owner for any loss, cost or expenses suffered by the Owner due to the Contractor's failure or negligence to comply with any of the aforesaid laws or in case the Owner is treated as a principal Owner or the like.

5.7.2.1. The Contractor shall maintain records of wages and other remuneration paid to his employees in such form as may be convenient and to the requirements of the Owner and the relevant Governmental Authority and the same shall include the following particulars of each worker.

a) Name, Worker's Number and Grade
b) Rate of Daily or monthly wage
c) Nature of Work on which employed
d) Total number of days worked during each wage period
e) Total amount payable for the work during each wage period
f) All deductions made from the wage with details in each case of the ground for which the deduction is made.
g) Wage actually paid for each wage period.

The Contractor shall provide a wage slip for each worker employed on the Works. The wage records and wage slips shall be preserved for at least Twelve (12) months after the last entry.

The Contractor shall allow inspection of the aforesaid wage records and wage slips at a convenient time and place after due notice is received, to the Owner or any other person authorised by him on his behalf. The Contractor shall extend full co-operation to the inspecting officers of the relevant Governmental Authority and ensure compliance with the requirements observed by the inspecting officers.

5.7.3. IMPLEMENTATION OF APPRENTICES ACT 1961

The Contractor shall comply with the provision of the Apprentices Act 1961 and the rules and orders issued there under from time to time. If he fails to do so, his failure shall be a breach of the Contract and the Owner, on the recommendation of the Engineer-In-Charge may, at his discretion, cancel the Contract. The Contractor shall also be liable for any pecuniary liability arising on account of any violation by him of the provision of the Act.

5.7.4. CONTRACTOR TO INDEMNIFY THE OWNER

5.7.4.1. The Contractor shall indemnify the Owner and every member, officer and employee of the Owner against all actions, proceedings, claims demands, costs and expenses whatsoever arising out of or in connection with the matters referred to in this Section VI and elsewhere and all actions, proceedings, claims, demands, costs and expenses which may be made against the Owner for or in respect of or arising out of any failure by the Contractor in the performance of his obligations under the Contract Documents. The Owner and Engineer-In-charge shall not be liable for or in respect of any demand or compensation payable by Applicable Law in respect or in consequence of any accident or injury to any workmen or other person in the employment of the Contractor or his Sub-Contractor and Contractor shall indemnify and keep indemnified the Owner and Engineer-I-charge against all such damages and compensations and against all claims, damages, proceedings, costs, charges and expenses whatsoever in respect thereof or in relation thereto.

5.7.5. PAYMENT OF CLAIMS AND DAMAGES

Should the Owner have to pay any money in respect of such claims or demands as aforesaid, the amount so paid and the costs incurred by the Owner shall be charged to and paid by the Contractor and the Contractor shall not be at liberty to dispute or question the right of the Owner to make such payments, notwithstanding the same may have been made without his consent or authority or in law or otherwise to the contrary.

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

5.7.6. HEALTH AND SANITARY ARRANGEMENTS FOR WORKERS

In respect of all labour directly or indirectly employed in the Works for the performance of the Contractor's part of this Contract, the Contractor shall comply with or cause to be complied with all the rules and regulations of the local sanitary and other authorities or as framed by the Owner from time to time for the protection of health and sanitary arrangements for all workers. Contractor has to pay, if applicable, to the local Governmental Authority, extra water and sewerage charges, or any other charges as applicable under otherwise specified section or Tender Information and Instruction form.

5.7.7. HOUSING FOR THE EMPLOYEES, STAFF, LABOUR AND PERSONNEL

The Contractor shall provide and maintain such temporary accommodation and amenities as may be reasonable necessary for itself and its staff and employees (including with respect to the Contractor's Personnel) employed at the Site, including all fencing, water supply (both for drinking and other purposes), electricity supply, sanitation, fire prevention and fire-fighting equipment and other agreed requirements in connection with such accommodation or amenities.

5.7.8. SAFETY REGULATIONS

5.7.8.1. In respect of all labour, directly or indirectly through Sub-Contractors employed in the Work for the performance of Contractor's part of this Contract, the Contractor at his own expense arrange for all the safety provisions as per safety codes of C.P.W.D., Indian Standards Institution, The Electricity Act, The Mines Act and such other acts as applicable.

5.7.8.2. The Contractor shall observe and abide by all fire and safety regulations approved by the Owner. Before starting Work, Contractor shall consult with Owner or Engineer-In-Charge and must make good to the satisfaction of the Owner any loss or damage due to fire to any portion of the Works done or to be done under this Contract or to any of the Owner's existing property.

5.7.8.3. The Contractor shall provide and maintain weatherproof sheds for storage of materials and working areas for materials, mixing of concrete, casting yards, etc., both for his own use and the Owner and clear away the same on completion of all Works.

SUB-SECTION- VIII

5.8. SAFETY CODE

5.8.1. GENERAL

"*Contractor shall adhere to safe construction practice and guard against hazardous and unsafe working conditions and shall comply with safety rules as set forth herein. Prior to start of construction, Contractor shall furnish copies of "Safety Code" for information and guidance. Any expenses/cost incurred for the purpose shall be borne & paid by the Contractor, wherever possible or Owner may consider reimbursement of part cost based on mutual agreement.*

The Contractor shall adhere to the Safety practices as per BIT Construction Safety Manual provided under ***Annexure 1*** *for maintaining minimum safety standards and implementation at site*."

5.8.1.1. Responsibility for Safety & Environmental Requirements

(a) The Contractor acknowledges and agrees that the overall co-ordination of safety and environmental matters relating to the Project including those affecting the Contractor's Personnel will be exercised by the Owner. This does not relieve the Contractor of its responsibilities relating to its personnel or the Works.

(b) The Contractor must at all times exercise all necessary precautions for the safety of all persons on the Site, members of the public who may be affected by the Works and the protection of the environment.

5.8.1.2. Compliance with Legislation and Safety Management System

5.8.1.2.1 From the commencement of the Works until the end of all Defects Liability Periods or the date of the making good of all defects, the Contractor must comply with all relevant statutory requirements, Codes of Practice, Indian Standards, the Owner's internal Safety Management System, and directions by the Owner in relation to environmental and safety matters.

5.8.1.2.2 In addition to the above requirements, the Contractor must:

5.8.2. Safe Work Procedures and Practices

5.8.2.1. provide materials which are adequately equipped, guarded, protected, approved and serviced on a regular basis and to manufacturer's specification so as to maintain safety protection for the Contractor's Personnel, other persons on the Site, members of the public who may be affected by the Works and protection to the environment;

5.8.2.2. ensure that all electrical installations, materials, extension cords, fittings and the like provided for the Works comply with the requirements of the Owner and all relevant authorities;

5.8.2.3. here working loads on these structures are capable of being exceeded, then, prior to commencing work, advise the Owner of that fact and must design and construct temporary supports satisfactory to the Owner which are sufficient in all respects to support the working loads on these structures. Work must not be carried out by the Contractor on structures where working loads exceed the safe working loads either advised by the Owner or determined by the Contractor;

5.8.2.4. obtain a hot work permit approved by both the Owner and the Contractor for any activity that involves the potential for fire or explosion;

5.8.2.5. ensure first aid facilities with certified first aid attendants are provided and maintained and supplement them with other facilities as necessary for the proper and safe execution of the Works;

5.8.2.6. where the Contractor's personnel carry out work on the Site outside usual working hours, ensure the attendance at the Site during those hours of at least one of the Contractor’s Personnel who is a certified first aid attendant;

5.8.2.7. provide to the Owner, in a form acceptable to the Owner, Material Safety Data Sheets, copies of Safety Management System risk assessments and management inspection procedures in respect of chemicals or substances to be brought to or taken from the Site, prior to their delivery to the Site;

5.8.2.8. obtain and maintain in a register all relevant licenses, permits, environmental impact assessment and other instruments which are required by law; and

5.8.2.9. ensure that all-safe work procedures and practices developed for the Works meet the minimum criteria of the Owner's internal Safety Management System Standards.

5.8.3. MINIMUM PERSONAL PROTECTIVE EQUIPMENT (PPE)

5.8.3.1. Proper PPE shall be made available by the respective worker’s owner for the use of all workers exposed to hazards at site.

5.8.3.2. PPE shall be regularly maintained and kept in good condition with the provision of proper storage and / or cleaning facilities for PPE.

5.8.3.3. All workers shall be properly instructed in the need for and use, cleaning, and maintenance of, PPE. They shall also be given proper fitting for PPE requiring special attention, such as respirators and eye protection.

5.8.3.4. On a regular basis (in accordance with manufacturers standards and site conditions), supervisors are required to check PPE to see that it is in a serviceable condition.

5.8.3.5. The issuance of PPE shall be recorded with documents kept at site for inspection by the relevant authority or interested parties such as third-party auditors.

5.8.3.6. Head Protection

5.8.3.6.1 Safety hard hats or helmets shall be worn where there is a danger from impact and penetration from falling or flying objects or from limited electric shock. Generally safety helmets shall be worn by all persons at all times on Site.

5.8.3.6.2 Safety hard hats shall have inner liner & chin strap and should be comfortable for the user and should fit his or her head properly.

5.8.4. Foot / Toe Protection

5.8.4.1. The wearing of sound footwear (leather uppers, resilient and rigid soles) is the minimum acceptable standard on Site. Persons engaged in scaffolding and roofing works may be permitted to wear suitable shoes.

5.8.4.2. In areas where there is a potential for foot / toe injuries, approved safety shoes / boots shall be worn. Safety boots / shoes should meet national or international standards.

5.8.5. Eye Protection

5.8.5.1. Safety glasses with side-shields, goggles, full face shields, welders lens are the types of protection needed where machines or operations present a danger from flying objects, direct or reflected brightness, hazardous liquids, or injurious radiation.

5.8.5.2. Eye protection devices should fit comfortably (snugly, not interfere with movement) on the user's face.

5.8.6. Hearing Protection

5.8.6.1. Generally, approved hearing protectors (ear mufflers, disposable and non-disposable ear plugs) shall be made available to all personnel entering into noise-exposed areas of more than 85 dBA. Work processes / equipment that generate such high noise levels at a typical construction site include: piling, grinding, concrete hacking / chipping, circular saw, concrete vibrator / poker, compactor, etc.

5.8.6.2. Hearing protectors should be of proper fit and of the correct type for the noise exposure.

5.8.7. Safety Belts / Harnesses

Safety harnesses (full body type) shall be worn and properly secured to an approved fixing device where a person is exposed to an unprotected edge / opening where such a person can fall greater than two (2) metres.

5.8.8. Respiratory, Hand, & Protective Clothing Protection ~ Minimum PPE standard to be resolved.

Note "Approved" means approval by Authority and / or approval by recognised Testing / Certification Authority as per the Indian Legislation / Regulation / Standard Code.

5.8.9. In addition to the above requirements, the Contractor must:

5.8.9.1. undertake regular formal and informal safety inspections to determine any previously unidentified significant risks, management system deficiencies, and the level of compliance with the Owner Safety Management System and be able to demonstrate that these inspections have occurred;

5.8.9.2. establish a register for and, where required, provide evidence to the Owner of all licenses, registrations, orders and approvals, and all renewals thereof required of the Contractor for the Works, including those for the disposal of any materials under any occupational health and safety and environmental legislation;

5.8.9.3. prior to delivery of any plant and equipment to the Site, provide to the Owner a schedule of the details of the plant and equipment, the regulatory operating conditions and the current maintenance and inspection records applicable to that plant and equipment;

5.8.9.4. regularly provide to the Owner the proposed dates, times and scope of Contractor inspections and audits of the Works and co-operate with the Owner to enable inspections and audits of the Site;

5.8.10. Roles and Responsibilities

5.8.10.1. Ensure the Contractor's safety supervisor, as nominated in the Appendix:

(1) is present on Site at the times reasonably required by the Owner;

(2) is in regular attendance at safety meetings and inspections or other similar meetings required by the Owner;

(3) records and reports to the Owner safety information required by the Owner;

(4) completes daily safety inspections; and

(5) prepares ongoing risk assessments and safe work procedures.

5.8.11. Skill Enhancement and Training

5.8.11.1. The Contractor should be able to demonstrate that the Contractor's Personnel are conversant with and adhere to all relevant occupational health and safety and environmental legislation, standard codes of practice, Specifications, including Site safety and environmental instructions issued by the Owner;

5.8.11.2. The Contractor should be able to demonstrate that the Contractor's Personnel are involved with the preparation of the risk assessment process and the preparation and compliance of safe work practices and procedures;

5.8.11.3. The Contractor should be able to demonstrate that the Contractor's Personnel are adequately trained and instructed in accordance with requirements of Applicable Laws. The Contractor must ensure that its personnel are not directed or expected to undertake work or activities which might be detrimental to the environment or the safety, health or welfare of themselves or others.

5.8.12. Site Safety Instructions

In addition to the above requirements, the Contractor must ensure that it and its personnel comply with the following specific Site Safety Instructions.

5.8.12.1. All incidents, accidents and equipment damage shall be reported immediately to the Owner's Site Manager.

5.8.12.2. The Contractor shall provide first aid equipment required by law based on its number of workers employed on Site. Further, depending on the Contractor's number of workers, the Owner may require it to have on Site at all times, a qualified nurse.

5.8.12.3. A safety committee shall be established, representing the Owner's employees and contractors. This safety committee shall meet on a regular basis.

5.8.12.4. Safety footwear must be worn at all times. Damaged or worn out shoes must be replaced.

5.8.12.5. Safety helmets shall be worn at all times by all persons on Site.

5.8.12.6. Approved hearing protectors shall be provided for and worn by all personnel entering into noise exposed areas of more than 85 dBA.

5.8.12.7. Work areas must be kept clean and tidy with rubbish and other safety hazards cleaned up promptly. Fire hazards such as garbage, oil rags and flammable materials must be promptly removed and corrective action is completed. All protruding nails or bolts shall be bent over or removed and all other dangerous protruding objects shall be removed or protected.

5.8.12.8. All openings in floors if over 150mm x 150mm will have 35mm x 35mm x 3mm mesh cast in be securely covered and / or have handrails, all in accordance with statutory requirements and the Owner's directions.

5.8.12.9. Signage and Handrails to penetrations, perimeters, stairs, walkways etc. shall be erected and maintained in a safe condition in accordance with statutory requirements and the Owner's directions.

5.8.12.10. Adequate fire protection shall be provided as necessary. In particular a suitable fire extinguisher shall be securely attached to each electric or oxy-acetylene or oxy-LPG welding plant brought on site.

5.8.12.11. Electric leads shall not be over-extended and shall be switched off at the point of power supply and removed when not in use.

5.8.12.12. Explosives shall not be used without the express permission of the Owner's site manager.

5.8.12.13. All necessary precautions shall be taken in the use of compressed air.

5.8.12.14. Hook or load riding shall not be permitted except in accordance with statutory authority nor shall passengers ride on material hoists, bulldozers, front-end loaders, forklifts or similar plant not intended for the carrying of personnel. Operators must have all required licences and certificates for the equipment being operated.

5.8.12.15. Clear and standard crane signals must be used at all times by licensed personnel.

5.8.12.16. All equipment such as front end loaders, bulldozers, backhoes and forklifts are to have their bucket or blade lowered when not in use and chocked or blocked during maintenance or repairs.

5.8.12.17. All working platforms, suspended or otherwise, shall conform to statutory requirements.

5.8.12.18. All hoists and scaffolding are to be in accordance with statutory requirements and approved in writing where required.

5.8.12.19. Ladders must be approved, extend 1.2 metre above landing, be set a correct angle 75° to horizontal and secured at all times.

5.8.12.20. Safety belts or harnesses shall be worn and properly secured to approved fixing device where no other form of protection is available.

5.8.12.21. Welding operations shall be screened to protect all personnel against welding flashes.

5.8.12.22. Personnel are required to wear approved eye protection whilst performing or exposed to operations that can cause eye injury.

5.8.12.23. No machinery, hand tools or any other type of equipment are to be operated without protective guards.

5.8.12.24. The Contractor will be required to modify guard or remove any plant or equipment, which does not meet the Owner's safety requirements or statutory requirements.

5.8.12.25. All operators of any explosive-powered tool shall be qualified and licensed in accordance with statutory requirements. A warning sign shall be displayed at each place where the tool is being used.

5.8.12.26. Trenches and excavations must be adequately shored and / or strutted before personnel are allowed to access it. Safe access shall be provided in all excavations.

5.8.12.27. Where petrol, diesel or gas powered equipment is used on site with the approval of the Owner, fuel therefore shall be stored only in satisfactory metal safety containers approved by the Owner and in accordance with statutory requirements.

5.8.12.28. Use of lasers on Site must be in accordance with statutory requirements and the Owner's direction.

5.8.12.29. Protective clothing shall be worn by personnel when exposed to and/ or working with the following - noxious chemicals, welding, heat and fire, all in accordance with statutory requirements.

5.8.12.30. Respiratory protective devices shall be worn for the protection against harmful substances, which could enter body through the respiratory system. Such harmful substances include dust, mist, fumes, smoke, gas and vapours.

5.8.12.31. Drugs of abuse shall not be brought on to or consumed on site. Persons affected are not permitted on Site.

5.8.12.32. Persons affected by alcohol are not permitted on Site.

5.8.12.32.1 Subcontractors are to supply all necessary safety equipment for their employees' use.

5.8.12.32.2 Industrial safety gloves and mittens for the protection of hands and portions of the arms shall be worn in areas of risk.

5.8.12.32.3 Prior to operating or directing the operation of cranes or lifting gear ensure equipment has current approval and Work is carried out by certified competent personnel.

5.8.12.32.4 No entry will be permitted to confine spaces until (a) means of entry and exits are agreed and (b) quality of air supply has been checked for oxygen deficiency, combustibility, and toxicity.

5.8.12.33. The Owner reserves the right to fine the Contractor who fails to comply with any of the requirements set out in this Section and non-implementation of EH&S minimum requirements.

5.8.12.34. Statutory requirements are to be treated as a minimum only and the Owner may impose higher standards.

5.8.12.35. Should one require any clarification on safety matters, contact should be made to the relevant Owner Site Manager.

5.8.13. EH&S Minimum Requirements

5.8.13.1. ***Fall Protection Requirements***

5.8.13.1.1 Guardrails are to be provided at all working places and other locations where persons or materials could fall more than 2.0m / 6ft. Where this can physically not be achieved suitable and sufficient fall protection devices that do not rely on individuals should be provided and used to establish a safe place of work. Harnesses and personal protective equipment must be used as a last resort. The decisions made and options implemented must be clearly detailed in the EH&S Plan and agreed with the Owner.

5.8.13.1.2 Holes, shafts and edges from or through which persons could fall a distance of more than 2 metres / 6ft must be clearly marked with signage or other means and be adequately protected by covers or barriers so as to prevent falls of persons and materials.

5.8.14. General - Physical Control Requirements

5.8.14.1.1 The Contractor must comply in full with all applicable EH&S local and national legislation. In circumstances where there is a conflict between local or national legislation and the Owner Global Minimum Requirements, the higher (more protective) requirement shall prevail.

5.8.14.1.2 All persons working on suspended scaffolds / cradles / gondolas must wear and use appropriate fall prevention equipment so as to protect them effectively at all times when they are at risk from any failure of any part of the scaffold / cradle / gondola, including its suspension system

5.8.14.1.3 Free-standing scaffold towers used externally must not be higher to the top platform level than three times the minimum base dimension, unless secured to a permanent structure. For internal use only, the height to platform may rise to 3.5 times the minimum base dimension. Wheels must be locked when towers are in use. No person is permitted to remain on a tower platform while a tower is being moved.

5.8.14.1.4 All temporary electrical circuits must include a residual current device, earth leakage circuit breaker or ground fault circuit interrupter at source.

5.8.14.1.5 Powered cranes and hoists, aerial platforms and scissor lifts must have a competent driver, certified by a qualified third party. Additionally, the above items must be certificated as safe to use by a qualified third party.

5.8.14.1.6 Adequate lighting must be provided to enable safe access to and egress from every place on a site where persons are liable to work, in addition to task lighting.

5.8.15. Waste Management

"*The Contractor shall adhere to the Construction Waste Management as provided under* ***Annexure 2*** *while dealing with construction waste at the site*."

5.8.15.1. Upon appointment, the Contractor is required to prepare and submit to the Owner for approval, a project-specific plan for the management of waste. The plan shall specifically address the following:

a) Waste management at design co-ordination meetings;
b) Practical measures associated with their works to prevent waste entering site;
c) Manage waste streams resulting from their works and identify waste that can be reused or recycled;
d) Meet local, state and federal waste management legislation and environmental standards, including waste minimisation;
e) Use building materials that are fully recycled and/or include recycled material in their production where practicable;
f) To avoid the generation of waste in all instances and prevent pollution and damage to the environment; and

g) To report monthly the amount of waste removed from site, reused, recycled or diverted productively from landfill.

5.8.16. Induction / Orientation for project workers

The Contractor shall ensure all workers receive a full project-specific EH&S induction / orientation before commencing any work onsite. Keeping a project log-recording numbers of all workers, the content of the induction / orientation and date of starting work shall validate this.

5.8.17. (Sub-)/Contractor training

The Contractor shall ensure all workers shall receive at least one specific task-related training / skills session per week. This may be achieved by using Toolbox talks & / or training in a specific Safe Work Method Statement.

5.8.18. Lost time injuries

The Contractor shall report lost time injuries and hours worked by all workers. The definition of a "lost-time injury' is one that results in absence from normal work on the shift following that during which the injury was suffered.

The Contractor shall follow up medical treatment and other statutory requirements till the injured person returns to duties or is properly compensated and rehabilitated. All these follow up shall be reported to the Owner on a daily basis.

5.8.19. Schedule of Fines

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Schedule of Charges to Contractors who are in breach of the Owner's Site Safety, Site Safety Cycle and Environmental Rules and Regulations

- Refer to Attached schedule **Annexure 3.**

1. Clause 5.15 (**Safety Co-ordinator**) of Section VIII (Security Code) of the Agreement shall be replaced with the following:

   "*The Contractor shall have a Safety Office or a Supervisor to be designated as a Safety Coordinator in order to specifically look into the implementation of different safety and construction waste requirements of the site work. The person thus designated will in general co-ordinate on matters of safety and in particular ensure that the Safety Manual and Construction Waste Management is complied with. His name shall be displayed on the notice board at a prominent place at the work site.*

   The ratio of 1:75, to be maintained at site. i.e., for every 75 workers at site one safety person shall be provided at site."

5.8.19.1.1 The contractor and sub-contractors, shall comply with the safety precautions, protective measures, house keeping requirements. The owner / architect, with due intimation. Shall have the right to stop the work at site, if in his opinion proceeding with the work will lead to an unsafe and dangerous condition. Contractor shall get the unsafe condition removed or provide protective equipment. 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. The contractor shall be held responsible for non-compliance if any of the safety measures and delays, implications, injuries, fatalities and compensation arising out of such situations or incidents.

5.8.20. TRAFFIC

5.8.20.1.1 The contractor shall organise operations by taking approval to use the existing roads, if any, from Owner.

5.8.20.1.2 The Contractor shall exercise full care to ensure that no damage is caused by him or workmen, during the operation, to the existing water supply, sewerage, power or telecommunication lines or any other services or works. The Contractor shall provide and erect before construction, substantial barricades, guardrails, and warning signs. Contractor shall furnish, place and maintain adequate warning lights, signals, etc., as required by Owner.

5.8.20.2.**SAFE MEANS OF ACCESS**

5.8.20.2.1 Adequate and safe means of access and exit shall be provided for all work places, at all elevations shall be avoided.

5.8.20.2.2 Suitable scaffolds shall be provided for workmen for all works that cannot safely be done from the ground, or from solid construction except such short duration work as can be done safely from ladders. Ladder shall be of rigid construction having sufficient strength for the intended loads and made of metal and all ladders shall be maintained well for safe working condition. Suitable footholds and handholds shall be provided on the ladder. The ladder shall be given an inclination not steeper than 1 in 4 (1 horizontal and 4 vertical).

5.8.20.2.3 Scaffolding or staging more than 3.5mm above the ground or floor, swung or suspended from an overhead support or erected with stationary support shall have a standard guard-rail properly attached, bolted, braced or otherwise secured at least 1m high above the floor or platform of such scaffolding or staging. The guardrail shall extend along the entire exposed length of the scaffolding with only such opening as may be necessary for the delivery of materials. Standard railing shall have posts not more than 2m apart and an intermediate rail half way between the floor and platform of the scaffolding and the top rail. Such scaffolding or staging shall be so fastened as to prevent it from swaying from the building or structure. Scaffolding and ladder shall conform to relevant IS specification (IS 3696-1966).

5.8.20.2.4 Working platforms of scaffolds shall have toe boards at least 15cm in height to prevent materials from falling down.

5.8.20.2.5 A sketch of the scaffolding proposed to be used shall be prepared prior to start of erection of scaffolding. Safety engineer shall examine all scaffolds before using.

5.8.20.2.6 Working platform, gangways and stairways shall be so constructed that they shall not sag unduly or unequally and if the height of the platform or gangway or stairway is more than 3.5m above ground level or floor level, they shall be closely boarded, shall have adequate width for easy movement of persons and materials and shall be suitably guarded.

5.8.20.2.7 The planks used for working platform shall not project beyond the end supports to a distance exceeding four times the thickness of the planks used. The planks shall be rigidly tied at both ends to prevent sliding and slippage. The thickness of the planks shall be adequate to take load of men and materials and shall not collapse.

5.8.20.2.8 Every opening in the floor of a building or in a working platform shall be provided with suitable means to prevent fall of persons or materials by providing suitable fencing or railing, the minimum height of which shall be 1m, along with 15cm high sheet obstruction at floor level along the railing.

5.8.20.2.9 Safe means of access shall be provided to all working platforms and other elevated working places. Every ladder shall be securely fixed. No single portable ladder shall be over 9m in length. For ladders up to 3m in length, the width between side rails in the ladders shall in no case be less than 300mm. For longer ladders, this width shall be increased by at least 20mm for each additional meter of length. Step spacing shall be uniform and shall not exceed 300mm.

5.8.20.2.10 Adequate precautions shall be taken to prevent danger from electrical lines and equipment. No scaffolding, ladder, working platform, gangway runs, etc. shall exist within 3m of any un-insulated electric wire. Whenever electric power and lighting cables are required to run through (pass on) the scaffolding or electrical equipment are used, such scaffolding structures shall have minimum two earth connections with earth continuity conforming to IS code of practice.

5.8.20.3. **EXCAVATION, TRENCHING AND EARTH REMOVAL**

5.8.20.3.1 All trenches 1.2m or more in depth shall at all times be supplied with at least one ladder for each spacing of 30m in length or fraction thereof. Ladder shall be extended from bottom of the trench to at least 1m above the surface of the ground.

5.8.20.3.2 The sides of the trench which are 1.2m or more in depth shall be stepped back to give suitable slope (angle of repose) or securely held by timber bracing, so as to avoid the danger of sides from collapsing. The excavated material shall not be placed within 1.5m of the edges of the trench or half of the depth of the trench, whichever is more. Cutting shall be done from top to bottom. Under no circumstances mining or undercutting shall be done.

5.8.20.3.3 The Contractor shall ensure the stability and safety of the excavation, adjacent structures, services and the works.

5.8.20.3.4 Open excavations shall be fenced off by suitable railing and warning signals installed at night at well-lit places so as to prevent persons slipping or falling into the excavations.

5.8.20.3.5 All blasting operations shall be carried out on the basis of procedures approved by inspector of explosives. All works in this connection shall be carried out as per IS code of practice. Barricades, warning signs, etc., shall be placed on the roads / open area.

5.8.20.3.6 a) As far as practical, earth shall be removed mechanically.

b) Wherever manual removal of earth is involved, earth shall be removed from the top by maintaining the proper slope equal to the angle of re-pose of the earth.

c) The contractor to ensure that no under-cutting is done shall constantly supervise such work.

5.8.20.4. **DEMOLITION**

5.8.20.4.1 Before any demolition work is commenced and also during the progress of the Work:

a) All roads and open area adjacent to the Work Site shall either be closed or suitably protected. Appropriate warning signs shall be displayed for cautioning approaching persons.

b) Before demolition operations begin, the Contractor shall ensure that the power on all electric service lines is shut off and the lines cut or disconnected at or outside the demolition site. If it is necessary to maintain electric power during demolition operation.

c) The required service lines shall be adequately protected against damage. Persons handling heavy materials / equipment shall wear safety shoes.

d) No floor, roof or other part of the building shall be overloaded with debris or materials as to render it unsafe.

e) Entries to the demolition area shall be restricted to authorised persons only.

5.8.20.5. **PERSONAL PROTECTIVE EQUIPMENT**

5.8.20.5.1 All necessary personal protective equipment shall be kept available for the use of the persons employed on the Site and maintained in a condition suitable for immediate use. Additionally, the Contractor shall take adequate steps to ensure proper use of equipment by those concerned. The personal protective equipment are to be provided by the Contractor are:

a) All persons employed at the construction site shall use safety helmets.

b) Workers employed on mixing asphaltic materials, cements and lime mortars shall use protective goggles, protective foot wear and hand gloves.

c) Persons engaged in welding and gas-cutting works shall use suitable welding face shields. The persons who assist the welders shall use suitable goggles. Protective goggles shall be worn while chipping and grinding.

d) Stone breakers shall use protective goggles. They shall be seated at sufficiently safe intervals of distance.

e) Persons engaged in or assisting in shot blasting operations and cleaning the blasting chamber shall use suitable gauntlets, overalls, dust-proof goggles, boots and protective hood supplied with fresh air at the minimum rate of 9m/hr.

f) All persons working at heights more than 4.5m above ground or floor and exposed to risk of falling down shall use safety belts, unless otherwise protected by cages, guard railings, etc. In places where the use of safety belts is impractical, suitable net of adequate strength fastened to substantial supports shall be employed.

g) Protective nets shall be provided at places where men are working at heights to safe guard against falling debris.

h) When workers are employed in sewers and inside manholes that are in use, the Contractor shall ensure that the manholes are opened and are adequately ventilated at least for an hour. After it has been well ventilated, the atmosphere inside the space shall be checked for the presence of any toxic gas or oxygen deficiency and recorded in the register before the workers are allowed to get into the manholes. The manholes opened shall be cordoned off with suitable railing and provided with warning signals or caution boards to prevent accidents. There shall be proper illumination in the night.

5.8.20.6. **PAINTING**

5.8.20.6.1 The Contractor shall not employ women on the work of painting with products containing lead in any form. Only men above the age of 18 years shall be employed on the work with lead paint. The following precautions shall be taken during the work:

a) Supply air respirators for use by the workers when paint is applied in the form of spray, or a surface having lead paint is dry rubber or scraped.

b) The workmen shall use overalls and adequate facilities shall be provided to enable the painters to wash at the cessation of work.

c) All painting jobs, especially those in which lead paints are used shall be kept under industrial hygiene surveillance.

5.8.20.6.2 Smoking, open flames or sources of ignition shall not be allowed in places where paints and other flammable substances are stored, mixed or used. A caution board, with the instructions written in national / regional language, “SMOKING IS PROBHITED” shall be displayed in the vicinity where painting is in progress or where paints are stored. Symbols shall also be used for caution boards.

Suitable fire extinguishers / sand buckets shall be kept available at places where flammable paints are stored, handled or used.

When painting work is done in a closed room or in a confined space, adequate ventilation shall be provided. If adequate ventilation cannot be provided, workers shall wear suitable respirators.

5.8.20.6.3 Epoxy resins and their formulations used for painting shall not be allowed to come in contact with the skin. The workers shall use plastic gloves and / or suitable barrier creams.

Adequate ventilation shall be provided especially when working with hot resin mixes.

Increased personal hygiene shall be practiced to control inadvertent contact with the resin and eliminate its effects.

Workers shall thoroughly wash hands and feet before leaving the work. Work clothes shall be changed and laundered frequently.

5.8.20.7. **LIFTING MACHINES AND TACKLES**

5.8.20.7.1 Use of lifting machines and tackles including their attachments, anchorage and supports shall conform to the following standards or conditions:

a) Lifting machines and tackles shall be of good mechanical construction, sound material and adequate strength and free from any defects and shall be kept in good repair and in good working order.

b) Every rope used in hoisting or lowering materials or as a means of suspension shall be of good quality and adequate strength and free from any defect.

c) Every crane operator or lifting appliance operator shall be properly qualified. No person under the age of 21 years shall be in charge of any hoisting machine or give signal to operator of such machine.

d) In case of every lifting machine (and of every chain, ring, hook, shackle, swivel and pulley block used in hoisting or as means of suspension), the safe working load shall be ascertained and clearly marked. In case of a lifting machine having a variable safe working load, each safe working load and the conditions under which it is applicable shall be clearly indicated. No part of any machine or any gear referred to above in this paragraph shall be loaded beyond the safe working load except for the purpose of testing. The safety engineer shall approve this.

e) The safety engineer shall note the safe working load. Regarding other machines, the Contractor shall notify the safe working load of the machine to

the safety engineer, whenever he brings any machinery to site of work and get it verified by the safety engineer.

f) Thorough inspection and load testing of lifting machines and tackles shall be done by a competent person at least once every 2 months, and records of such inspection and testing shall be maintained.

5.8.20.7.2 Motors, gearing transmission, couplings, belts, chain drives and other moving parts of hoisting appliances shall be provided with adequate safeguards. Hoisting appliances shall be provided with such means as will reduce to the minimum the risk of any part of a suspended load becoming accidentally displaced or lowered.

5.8.20.8. **WELDING AND GAS CUTTING**

5.8.20.8.1 Welding and gas cutting operations shall be done by qualified and authorised persons and as per the relevant IS specifications and code of practice.

5.8.20.8.2 Welding and gas cutting shall not be carried out in places where flammable or combustible materials are kept and where there is danger of explosion due to presence of gaseous mixtures.

5.8.20.8.3 Welding and gas cutting equipment including hoses and cables shall be maintained in good condition.

5.8.20.8.4 Barriers shall be erected to protect other persons from harmful rays from the work. When welding or gas cutting is done in elevated positions, precautions shall be taken to prevent sparks or hot metal falling on persons or flammable materials.

5.8.20.8.5 Suitable type of protective clothing consisting of fire resistant gauntlet gloves, leggings, boots and aprons shall be provided to workers as protection from heat and hot metal splashes. Welding shields with filter glasses of appropriate shade shall be worn as face protection.

5.8.20.8.6 Adequate ventilation shall be provided while welding in confined space or while brazing, cutting or welding zinc, brass, bronze, galvanized or lead coated materials.

5.8.20.8.7 Welding and gas cutting shall not be done on drums, barrels, tanks or other containers unless they have been emptied cleaned thoroughly and it is made certain that no flammable material is present.

5.8.20.8.8 Fire extinguisher shall be available near the location of welding operations. Fire safety permit shall be obtained for working at vulnerable areas and operating areas before flame cutting / welding is taken up.

5.8.20.8.9 For electric (arc) welding the following additional safety precautions shall be taken:

a) When electrical welding is undertaken near pipelines carrying flammables, such pipelines shall not be used as part of earth conductor but a separate earth conductor shall be connected to the machine directly from the job.

b) Personnel contact with the electrode or other live parts of electric welding equipment shall be avoided.

c) Extreme caution shall be exercised to prevent accidental contact of electrodes with ground.

d) The welding cable shall not be allowed to get entangled with power cables. It shall be ensured that movement of materials does not damage the cables.

5.8.20.9. **GRINDING**

5.8.20.9.1 All portable grinders shall be used only with their wheel guards in position to reduce the danger from flying fragments, should the wheel break during the use.

5.8.20.9.2 Grinding wheels of specified diameter only shall be used on a grinder – portable or pedestal - in order to not exceed the prescribed peripheral speed.

5.8.20.9.3 Goggles shall be used during grinding operation.

5.8.20.10. **HOUSE KEEPING**

5.8.20.10.1 The Contractor shall at all times keep his work spot, site office and surroundings clean and tidy from rubbish, scrap, surplus materials and unwanted tools and equipment.

5.8.20.10.2 Welding and other electrical cables shall be so routed as to allow safe traffic by all concerned.

5.8.20.10.3 No materials on any of the Sites of Work shall be so stacked or placed as to cause danger or inconvenience to any person or the public.

5.8.20.10.4 At the completion of the Work, the Contractor shall ensure removal from the Work premises all scaffoldings, surplus materials, rubbish and all huts and sanitary arrangements used / installed for workmen on the site.

5.8.20.11. **FIRE SAFETY**

5.8.20.11.1 All necessary precautions shall be taken to prevent outbreak of fires at the construction site. Adequate provisions shall be made to extinguish fires, should they still break out.

a) Quantities of combustible materials like timber, bamboo, coal, paints, etc. shall be the minimum required in order to avoid unnecessary accumulation of combustibles at site.

b) Containers of paints, thinners and allied materials shall be stored in a separate room, which shall be well ventilated, and free from excessive heat, sparks, flame or direct rays of the sun. The containers of paint shall be kept covered or properly fitted with lid and shall not be kept open except while using.

c) Fire extinguishers shall be located at the construction Site at appropriate places.

d) Adequate number of workmen shall be given education and training in fire-fighting and extinguishing methods

5.8.20.12. **WORK IN RADIATION AREA**

The Contractor shall follow the stipulated procedure regarding Work in the radiation are and other works related with radiography.

5.8.20.13. **WORK IN AND AROUND WATER BODIES**

When the Work is done near any places where there is risk of drowning, all necessary rescue equipment such a life buoys and life jackets shall be provided and kept ready for use and all necessary steps taken for prompt rescue of any person in danger and adequate provision shall be made for prompt first-aid treatment of all injuries likely to be sustained during the course of the work. Persons who do not know swimming shall not be engaged alone for any work where risk of drowning exists. Sufficient number of life buoys or life jackets shall be provided.

5.8.20.14. **MEDICAL FACILITIES**

5.8.20.14.1 The Contractor shall arrange for medical aid and treatment for his staff and workers engaged on the Work Site including the first-aid facilities if they are not available at the project site.

5.8.20.14.2 First-aid appliance including sterilized dressing, cotton wool and antiseptic cream shall be made available at readily accessible places at every Work Site. These shall be maintained in good order under the charge of a responsible person.

5.8.20.14.3 At large work places where hospital facilities are not available within easy reach of the work, first-aid posts shall be established. Ambulance availability shall be identified during the entire period of Work for attending to injury cases.

5.8.20.15. **SAFETY CO-ORDINATOR**

1. "*The Contractor shall have a Safety Office or a Supervisor to be designated as a Safety Coordinator in order to specifically look into the implementation of different safety and construction waste requirements of the site work. The person thus designated will in general co-ordinate on matters of safety and in particular ensure that the Safety Manual and Construction Waste Management is complied with. His name shall be displayed on the notice board at a prominent place at the work site.*

The ratio of 1:75, to be maintained at site. i.e., for every 75 workers at site one safety person shall be provided at site."

The Contractor shall have a Safety Office or a Supervisor to be designated as a Safety Coordinator in order to specifically look into the implementation of different safety requirements of the Site Work. The person thus designated will in general co-ordinate on matters of safety and in particular ensure that the Safety Manual is complied with. His name shall be displayed on the notice board at a prominent place at the work site.

5.8.20.16. **REPORTING OF ACCIDENT**

5.8.20.16.1 All accident leading to property damage and / or personnel injuries shall be reported to the concerned authorities viz. Insurance Co. Police, Head Office, Regional Office, etc.

5.8.20.16.2 Contractor shall also submit a monthly statement of accidents to the General Manager (P&A) by 4th of every month showing details of accident, nature of injury including disability, days lost, treatment provided, etc., and the extent of property damage.

5.8.20.17. **PUBLIC PROTECTION**

The Contractor shall make all necessary provisions to protect the public. He shall be held responsible for defence of every action of other proceedings at law that may be brought by any person for injury sustained owing to neglect of any precaution required to taken to protect the public.

5.8.20.18. **OTHER STATUTORY PROVISIONS**

All operations involving the transport, handling, storage and use of explosive shall be as per the standing instructions and conform with the latest Indian Explosives Act and

the Explosives Rules. Handling, transport, storage and use of compressed gas cylinders and pressure vessels shall conform to the latest Gas Cylinder Rules and Static and Mobile Pressure Vessels (Unfired) Rules. In addition, the Indian Electricity Act and Indian Electricity Rules - latest, the Atomic Energy Act, the Radiation Protection Rules - latest, Radiation Protection Manual of Nuclear Facilities and the Atomic Energy (Factories) Rules - latest, and various latest rules and Acts related to mining shall also be strictly complied with.

5.8.20.19. GUIDELINES AND GENERAL PROCEDURES FOR SUPPLY AND USE OF ELECTRICITY AT SITE

5.8.20.19.1 GENERAL

Following safety requirements shall be complied with before the Contractor uses the power supply.

a. The Contractor shall submit a list of licensed electrical staff to be posted at Site.

b. It shall be the responsibility of the Contractor to provide and maintain complete installation on the load side of the supply point with regard to the safety requirements at Site. All cabling and installation shall comply with the appropriate latest statutory requirements given below and shall be subject to approval of the EIC at site: clearance as applicable at site

i. Indian Electricity Act.
ii. Electricity (Supply) Act.
iii. Indian Electricity Rules.
iv. National Electricity Code.
v. Other relevant rules of Local Bodies and Electricity Boards.

c. The power supply shall be regulated as per the terms and conditions of the supply of the respective electricity boards.

d. Where distribution boards are located at different places, the Contractor shall submit schematic drawing indicating all details like size of wires, overhead and cable feeders, earthing, etc. The position and location of all equipment and switches shall be given.

e. The Contractor shall make his own arrangement for main earth electrode and tapings thereof. The existing earth points available at site can be used at the discretion of the Owner with prior permission. Method of earthing, installation and earth testing results shall conform to relevant IS specifications (IS-3043).

f. All three phases' equipment shall be provided with double earthing. All light fixtures and portable equipment shall be effectively earthen to main earthing.

g. All earth terminals shall be visible. No gas pipes and water pipes shall be used for earth connection. Neutral conductor shall not be treated as earth wire.

h. The Contractor shall not connect any additional load without prior permission of the Owner.

i. Joints in earthing conductors shall be avoided. Loop earthing of equipment shall not be allowed. However, tapings from an earth bus may be done.

j. The entire installation shall be subjected to the following tests before energisation of installation including portable equipment:-

i. Insulation resistance test.
ii. Polarity test of switches.
iii. Earth continuity test.
iv. Earth electrode resistance.

k. The test procedures and their results shall conform to relevant standards.

Following guidelines are provided for general observations:

5.8.20.19.2 INSTALLATION

a) Only persons having valid wireman's license / competency certificate shall be employed for carrying out electrical work and repair of electrical equipment, installation and maintenance at Site. A qualified licensed Supervisor shall supervise the job.

b) Electrical equipment and installations shall be installed and maintained as to prevent danger from contact with live conductors and to prevent fires originating from electrical causes like short circuits, overheating etc. Installation shall not cause any hindrance to movement of men and materials.

c) Materials for all electrical equipment shall be selected with regard to working voltage, load and working environment. Such equipment shall conform to the relevant standards.

d) The minimum clearance to be maintained for all overhead lines along roads and across roads shall be as per the statutory requirements.

e) Grounding conductor of wiring system shall be of copper or other corrosion-resistant material. An extra grounding connection shall be made in appliances / equipment where chances of electric shock is high.

f) Electric fuses and / or circuit breakers installed in equipment circuits for short circuit protection shall be of proper rating. It is also recommended that high

rupturing capacity (HRC) fuses are used in all circuits. For load of 5 kW or more, earth leakage circuit breaker shall be provided in the circuits.

g) Wherever cables or wires are laid on poles, a guard wire of adequate size shall be run along the cables / wires and be earthen effectively. Metallic poles as a general rule, shall be avoided and if used shall be earthen individually. Anti-climbing guards and danger notices shall be provided on poles. Each equipment shall be an individual isolating switch.

h) Wires and cables shall be properly supported and an approved method of fixing shall be adopted. Loose hanging of wires and cables shall be avoided. Lighting and power circuits shall be kept distinct and separate.

i) Reinforcement rods or any metallic part of structure shall not be used for supporting wires and cables, fixtures, equipment, earthing, etc.

j) All cables and wires shall be adequately protected mechanically against damages. In case the cable is required to be laid underground, it shall be adequately protected by covering the same with bricks, Plain Cement Concrete (PCC) tile or any other approved means.

k) Using suitable cable glands shall properly terminate all armoured cables. Using cable lugs / sockets shall connect multi-stranded conductor cables. Cable lugs shall preferably be crimped. They shall be of proper size and shall correspond to the current rating and size of the cable. Twisted connections will not be allowed.

l) All cable glands, armouring and sheathing of electric cable, metal circuits and their fittings, metallic fittings and other non-current carrying parts of electrical equipment and apparatus shall be effectively grounded.

m) All the distribution boards, switch fuse units, bus bar chambers, ducts, cubicles etc. shall have MS enclosures and shall be dust, vermin and waterproof. The distribution boards, switches, etc. shall be so fixed such that they shall be easily accessible. Changes shall be done only after the approval of the Owner.

n) The Contractor shall provide proper enclosures / covers for protection of the entire switchboard, equipment, etc. against rain. Exposed live parts of all electrical circuits and equipment shall be enclosed permanently. Crane trolley wires and other conductor which cannot be completely insulated shall be placed such that they are inaccessible under normal working conditions.

o) Ironclad industrial type plug outlets are preferred for additional safety.

p) Open type distribution boards shall be placed only in dry and ventilated rooms; they shall not be placed in the vicinity of storage batteries or otherwise exposed to chemical fumes.

q) Isolating switches shall be provided close to equipment for easy disconnection of electrical equipment or conductors from the source of supply when repair or maintenance work has to be done on them.

r) In front of distribution boards, a clear space of 90 cm shall be maintained in order to have easy access during an emergency.

s) Adequate working space shall be provided around electrical equipment, which require adjustment or examination during operation.

t) As far as possible, electrical switches shall be excluded from a place where there is danger of explosion. All electrical equipment such as motors, switches and lighting fittings installed in workroom, where there is possibility of explosion hazard, shall be explosion proof.

u) All connections to lighting fixtures, starters or other power supplies shall be provided with PVC insulate, PVC sheathed twin / three / four core wires to have better mechanical protection for preventing possible damage to equipment or injury to personnel. Taped joints shall not be allowed and the connections may be made in looping system. Electric starter of motors, Switches shall not be mounted on wooden boards. Only sheet steel mounting or iron framework shall be used.

v) All the lighting fixtures and lap holders shall be of good quality and in good condition. Badly repaired or broken holders, etc. shall not be used.

w) Only PVC insulated and PVC sheathed wires or armoured PVC insulated and sheathed cables shall be used for external power supply connections of temporary nature. Weatherproof rubber wires shall not be used for any temporary power supply connections. Taped joints in the wires shall not be used.

x) The bulbs / lamps used for illumination and testing purpose shall have cover or guard to protect them from accidental breakage. Only 24 V supply system shall be used for hand lamps, etc. while working inside metallic tanks or conducting vessels.

5.8.20.19.3 OPERATION & MAINTENANCE

a) All persons, who work with electrical installation / equipment, shall be aware of the electrical hazards, use of protective devices and safe operational procedures. They shall be given training in fire-fighting, first aid and artificial resuscitation techniques.

b) The Contractor shall instruct the workers in the proper procedure, specify and enforce the use of necessary protective equipment, such as adequately insulated pliers, screw drivers, fuse pulleys, testing lamps and similar hand tools. Only wooden ladders shall be used to reach the heights in electrical work.

c) No material or earthwork shall be allowed to be dumped below or in the vicinity of the bare overhead line conductors.

d) Before any maintenance work is commenced on electrical installations / equipment, the circuits shall be de-energised and ascertained to be dead by positive test with an approved voltage-testing device. Switches shall be tagged or the fuse holders withdrawn before starting the work. Adequate precautions shall be taken in two important aspects viz.

i) That there shall be no danger from any adjacent live parts; and

ii) That there shall be no chances of re-energisation of the equipment on which the persons are working.

e) While working on or near a circuit, whenever possible the use of one hand may be practiced even though the circuit is supposed to be dead. The other hand may preferably be kept in pocket.

f) When it is necessary to touch electrical equipment (for example when checking for overload of motors) back of the hand may be used. Thus, if accidental shock were to cause muscular contractions, one would not 'freeze' to the conductor.

g) Operations of electrical equipment shall be avoided which standing on wet floor or when hands are wet.

h) Before blown fuses are replaces, the circuit shall be locked out and an investigation shall be made for the cause of the short circuit or overload.

i) When two persons are working within reach of each other, they shall never work on different phases of the supply.

j) When structural repairs, modification or painting work are to be undertaken, appropriate measures shall be taken for the protection of persons whose work may bring them into the priority of live equipment / circuit.

k) It shall be ensured that the insulation and wire size of extension cords are adequate for the voltage and current to be carried.

l) While tapping electricity from the socket, plug top must be used. It shall be ensured that no extension boards are over loaded while tapping. Only standard three pin plugs shall be used for tapping electricity. Broken sockets / plugs shall

be replaced immediately with good ones. Only joints free cables shall be used for connecting equipment / apparatus.

m) Floors shall be kept free from tailing electrical cables to avoid tripping hazard.

n) Power supply to the entire machines and lighting fixture shall be switched off when not in use.

o) Temporary electrical connections shall be removed as soon as the stipulated work is over. After completion of the works, the Contractor shall dismantle the distribution boards and the other facilities erected at site.

p) Unauthorised tapping of power by others from distribution boards under the control of the NCC shall be prohibited at all circumstances.

q) No flammable materials shall be stored in any working area near the switchboards.

r) "" *"Do Not Switch On"* "DANGER" Or *"Caution*" boards as applicable shall be used during maintenance works on the electrical equipment.

5.8.20.19.4 PORTABLE ELECTRICAL EQUIPMENT

a) Portable electrical equipment shall be regularly examined, tested and maintained to ensure that the equipment and its leads are in good order. Register shall be maintained for inspection recording the testing dates and results of the equipment.

b) All portable appliances shall be provided with tree core cable and three-pin plug. The third pin of the plug shall invariably be earthen. It shall be ensured that the metal part of the equipment shall be effectively earthen.

c) All connections to portable equipment or machines from the panel / distribution board / extension board shall be taken using 3 core double insulated PVC flexible copper wire in one length. No joints shall be allowed in this flexible wire. In case single length of wire is not sufficient for a particular location, then the supply can be tapped by providing another extension board comprising of switch and socket.

d) Flexible cables for portable lamps, tools and apparatus shall be regularly examined, tested periodically and maintained to ensure safety.

5.8.20.20. **SAFETY CODES IN CONSTRUCTION INDUSTRY**

5.8.20.20.1 EXCAVATION (IS-3764)

a. Location and protection of underground utility – viz. Water main, cables.

b. Barricade has to be provided all around the openings.

c. Area illumination has to be provided all along the ingress / egress routes / in and around the structure under construction with suitable warning signs at multiple locations.

d. Excavated material should be carted away as per the clause in Purchase Order.

e. Shoring for sides has to be provided where excavation is done to avoid the sides from collapsing.

f. Avoid vertical cuts.

g. Dewatering has to be done wherever required.

h. Equipment / vehicles to operate at safe distance away from the building.

i. Stability of other structures nearby to be ensured.

j. Gas cylinders not to be taken inside trenches.

k. Trenches greater that 4 ft. Depth should be provided with shoring – ladder for each 30 mtrs. Of excavated portion.

5.8.20.20.2 **BLASTING (IS-4081)**

Accidents are caused during blasting due to the following main reasons:

a) Wrong placement of charge in the blast hole.

b) Inadequate size of blast hole.

c) Wrong handling of explosives.

The following points should be observed during blasting operation:

a) Do not carry out blasting near any structure, foundation, column, crane, installation, etc.

b) Explosives should be of low sensitive to external influence (shock, friction, heat, sparks, etc.).

c) The radius to depth ration of the blast should be kept as low as possible so that the flight range of the fragments will be reduced.

d) The charge should be placed in such a way that the angle of throw of fragments would be between 85 to 90^0 with the horizontal.

e) Trans, Handling, storage of explosives should be as per Indian Explosive Act.

f) Supervision should be by experienced person.

g) Prior warning for evacuation to 400 meter away should be given.

h) If charge fails, should wait ½ hour.

i) Explosives should be stored in standard magazines.

j) There should be 'No smoking' signs.

k) Proper accounting of explosives should be undertaken.

l) Cases should be opened with wooden tools only.

m) Post flagmen – cordon off area.

n) Advise nearby residents of danger.

o) Use non-sparking tools/shoes.

p) Do not carry matches / open lights.

q) Use flameproof fittings / lights.

r) Children / unauthorised persons are not allowed in this area.

s) For electrical blasting, voltage shall not exceed 220v.

t) Do not carry on blasting under over-head power line/utility communication/utility lines.

u) Used loud siren to mark beginning & completion of blasting.

v) Only authorised persons should be allowed to go to misfired holes.

w) Misfired explosives to be disposed in accordance with Explosives Act

x) Leaky explosives to be washed with de-sensitising agents.

y) The charge should be placed in the boreholes only when the blasting operation is carried out – not earlier.

5.8.20.20.3 **CEMENT WORKS**

When working near loose cement / godowns – use gum boots, gloves, respirators.

5.8.20.20.4 **SCAFFOLDING (IS 4014(PART II))**

a) Clear the area of unwanted materials.

b) Erection under proper supervision.

c) Ensure ropes & cables are in good condition.

d) Ensure that all structural members and all connections are adequate.

e) Supports strong-adequate cross bracing

f) Ensure ground is safe and provide proper foot hold.

g) Keep ladder / working area free of grease / oil.

h) Passersby are protected.

i) Provide guardrails & toe board.

j) Wear safety belt, helmet while working on scaffolding.

k) Do not use the scaffolding for more than 15 days without rechecking.

l) Frequent inspection.

m) Excavation is not permitted near base of scaffolding.

5.8.20.20.5 **LADDERS (IS 3696 (PART II))**

a) Proper inspection – rungs/steps are not spliced.

b) Properly secured – top & bottom.

c) Side rails on fixed ladders to extend above top landing.

d) Build up ladders of sound material.

e) Rungs not to exceed 12 inches.

f) Step ladders fully open during use.

g) Metal ladders – prohibited near electrical lines.

h) Proper maintenance and storage after use.

5.8.20.20.6 **BARRICADES**

a) Floor openings covered / barricaded properly.

b) Road ways / side-walks protected.

c) Traffic control.

5.8.20.20.7 **CONCRETE CONSTRUCTION**

a) Forms properly installed and braced.

b) Adequate shoring, plumbing and cross bracing.

c) Shoring remains in place till strength attained.

d) Proper curing period & procedure.

e) Mixing & transporting equipment properly supported/routed.

f) Adequate runways.

g) Protection from cement dust.

h) Hard hats – safety shoes, skin covering.

i) Nails to be removed from shuttering material.

5.8.20.20.8 **MASONRY**

a) Proper scaffolding.

b) Dust protection.

c) Safe hoisting equipment.

5.8.20.20.9 **HOISTS, CRANES, DERRICKS**

a) inspect – cables, slings, chains, hooks, eyes

b) Equipment stability / supports.

c) Out riggers used if required.

d) Power lines removed/inactivated (cranes).

e) Signals understood and observed.

f) Experienced operators.

g) All equipment properly lubricated/maintained.

h) Protective head gears.

i) If person climbs on derrick installed for lifting material, special precautions should be taken.

j) Gas cylinders are kept in properly designed cages.

k) Periodical test/inspection of hoists, cranes.

l) Mark “safe working loads” on hoists/cranes.

m) Cranes to be operated by certified operator.

n) Ensure that slings are vertical.

o) Do not drag chains, slings, hooks and load over the floor.

p) Know the load before lifting.

5.8.20.20.10 **CONVEYORS:**

a) Proper inspection & maintenance.

b) Screens and other protection.

c) Adequate inspection and maintenance, ladders, light.

5.8.20.20.11 **HEAVY EQUIPMENT & TRUCKS**

a) Qualified operators with license.

b) Vehicle laws & regulations to be observed.

c) Check – breaks, lights, warning devices and wheels.

d) Weight limits – load sizes controlled.

e) Haul loads well maintained – properly laid.

f) Personnel not carried in unsafe manner.

g) Protection when equipment not used.

h) Planned inspection – maintenance.

i) Adequate equipment records

j) Proper oil, fuel, lubricants used.

5.8.20.20.12 **HOUSE KEEPING & SANITATION**

a) General neatness in working area.

b) Regular disposal of waste / trash.

c) Pathways and walkways clear.

d) Adequate lighting.

e) Sanitary facilities – clean.

f) Adequate drinking water.

5.8.20.20.13 **EMERGENCY PROCEDURE**

a) First aid station – properly manned.

b) First aid boxes – with items.

c) Injuries reported promptly.

d) Safety net used for heights – belts.

e) Adequate escape facilities.

f) Proper storage of tools when not being used.

5.8.20.20.14 **WELDING – CUTTING**

a) Qualified operators.

b) Proper screen, shield, goggles, gloves, clothing, equipment.

c) Electrical equipment – grounded – inspected.

d) Power cables protected & in good condition.

e) Fire extinguishers – available.

f) Inspection of fire hazards.

g) Flammable materials – protected (40 feet away).

h) Gas cylinders – upright & chained.

i) Gas line, torch in good condition.

j) Trolleys for moving cylinders.

k) Proper covering of mezzanine holes or barricades for cut portion.

l) Barricades / notices below mezzanine being cut – work permit (spl).

m) Helper also to use goggles.

5.8.20.20.15 **FLAMMABLE GASES – LIQUIDS**

a) "No smoking" signboard.

b) Containers clearly identified / marked.

c) Proper storage practices.

d) Proper storage temperature – protection.

e) Fire hazards to be checked.

f) Proper & adequate fire extinguishers.

g) Neat storage area – clear passages.

h) Material firmly stacked – not too high.

i) Entry restricted.

j) Store in separate enclosed area.

a) Proper number for operation.

b) Person picking up leads correctly.

c) Materials protected from heat / moisture.

d) Protection from falling into hoppers/bins.

e) Dust protection observed.

f) Extinguishers / fire protection available.

g) Traffic routing and control.

5.8.20.20.16 **POWER TOOLS**

a) Good house-keeping where used.

b) Tools – cords – earthing – in good condition.

c) Proper instructions for use.

d) Proper mechanical safe guards.

e) Tools nearly stored when not in use.

f) Right tool for job.

g) Proper wiring.

h) Proper training to operator.

i) Proper supervision.

j) Use of safety appliances – goggles – face shield.

k) Flying hazards checked up.

SUB-SECTION-IX

5.9. – QUALITY

5.9.1. Quality Assurance

5.9.1.1. **Section Includes**

Procedure for Contractor's Quality Management, Quality Planning and Quality Assurance requirements for implementing Quality Control on Site.

5.9.1.2. **Quality Management**

The Contractor's Quality Management Plan shall include all activities of the overall management function that determine the quality policy, objectivities and responsibilities and implements them by means of quality planning, quality assurance, quality control and quality improvement within the quality system.

5.9.1.3. **Quality Planning and Assurance**

A. The Contractor's Quality planning shall identify the quality standards that are relevant to the Project and determine the ways to satisfy them. The Quality Planning shall identify the inspection and testing needs of materials and construction.

B. The Contractor's Quality Assurance shall enable evaluation of the overall performance on a regular basis.

5.9.1.4. **Contractor's Quality Management Plan**

A. The Contractor shall establish a Project specific Quality Management Plan based on proven systems and standard procedures in conformance with ISO 9001 requirements and Owner's Quality Manual.

B. The Contractor shall furnish to the Engineer-In-Charge, as soon as practicable and in no event later than fifteen (15) days after receiving the Letter of Acceptance, a Project specific Quality Management Plan which shall include the Procedures / Method Statements, instructions and records to be used in-line with Owner's QA/QC Manual.

C. Prior to submittal of the Quality Management Plan for acceptance, the Contractor shall meet the Owner's Site quality head to discuss the Quality System. The meeting shall develop mutual understanding relative to details of the system, including the forms to be used for recording the QC operations, inspection, administration of the system and the interrelationship of Contractor and Consultant.

D. The Contractor's Quality Management Plan shall include the following:

1. Introduction addressing the quality statement, policy, scope, purpose, references, definitions, etc.

2. Contractor's organization and responsibilities.
3. Specific QA/QC organization relating to the Project.

4. Project specific Quality Planning, Assurance and Control.

5. The ISO 9001:2000 Project Quality System requirements.

6. List of relevant IS and International Standards.

E. The elaborated Project Quality System requirements shall include as a minimum, the following:

1. The QA/QC organization and qualification requirements of personnel.

2. Authority and area of responsibilities of the Contractor's personnel. The Contractor's QA/QC Manager shall not have any duties other than the implementation of the Quality programme.

3. Plan for accomplishing Quality Control inspections including that for his Sub-Contractor's work (How, what, where, when and why).

4. Detailed listing of designation of all testing to be performed, list of Inspection and Test Plans (ITPs) to be generated to cover all inspection and test activities (in-line with Owner ITP format). The designated person appointed by the Owner for coordinating on aspects relating to Site Quality will indicate which tests may be performed by the Contractor and those that must be performed by an approved Independent Testing Laboratory (ITL).

5. Documented procedures for Quality Control operations, inspections and testing (in-line with Owner's manual).

6. A copy of a letter of direction to each Contractor's Representative responsible for QA/QC, outlining his / her duties and responsibilities and signed by a responsible officer of the Contractor.

7. A narrative discussion of how Contractor's QA/QC staff will accomplish their assigned tasks.

F. Sub-Contractors shall not have a separate Project quality plan. The Contractor shall include any specific requirement of his subcontractor in his QA/QC plan. In doing so, the Contractor shall ensure that he fully coordinates with his Sub-Contractors.

G. Construction operations will not commence until the Quality Management plan has been accepted by the Site quality in charge. However, at the instruction of the

Project In-charge or Site quality in charge, the Contractor may be allowed to proceed on a specific phase of construction for which the plan has been submitted and accepted.

H. The Quality Management System shall be implemented by the establishment of separate QA/QC organization whose sole duty will be to ensure conformance to the Contract of all contractual activities.

I. The Contractor's QA/QC organization shall be sufficiently staffed to perform the following tasks:

1. Prepare detailed Inspection and Test Plans for approval of Site quality in charge.

2. Conduct phased inspections (preparatory, initial and follow-up) and approve inspection and test plans.

3. Perform all testing required under the technical paragraph of Contract.

4. Inspect materials as they are delivered on Site to ensure compliance with approved shop drawings and Contract Specifications.

5. Conduct off-site inspections of supply items fabricated or assembled and services to be incorporated into the work. Provide monthly report of off-site activities.

6. Maintain record of all QC activities. These records shall be available for Owner's use.

5.9.1.5. **Quality Assurance – Reviews and Audits**

A. Contractor shall establish processes for Quality reviews and audits.

B. The Contractor shall arrange and perform internal quality audits within their organization at regular period and copies such audits results shall be forwarded to Project In-charge / Site quality in charge for information.

C. Contractor shall have the full responsibility to ensure implementation of his Sub-Contractor's Quality Management System.

5.9.1.6. **QA/QC Organization and Personnel**

A. The Contractor shall have a QA/QC Manager who shall have an experience of at-least 10 (ten) years in the field.

B. The QA/QC Manager shall as a minimum be a qualified engineer with additional qualifications and training pertaining to Quality Management.

C. The Contractor QA/QC Manager shall have prior approval of the Site quality in charge.

D. The QA/QC Manager shall report directly to the Contractor's top management and in no case come under the hierarchy of the Contractor's Project Construction team.

E. The team of QA/QC personnel under the QA/QC Manager shall not report to the Contractor's Project Head.

F. The Owner's Project in-charge / Site Quality headhave the authority to remove any staff in the QA/QC team if in the opinion of the Project In-charge / Site uality Head, the performance of the said staff is not satisfactory. The replacement of such staff shall take place within 1ten (10) days of the Project In-charge / Site quality in charge's notice.

G. No staff shall be changed without the Project In-charge / Site quality in charge's written consent. The Contractor's and Sub-Contractor's senior Site staff shall be fluent in technical English.

H. The Contractor shall have the full responsibility to ensure implementation of his Sub-Contractor's Quality Management System.

I. The QA/QC personnel employed by the Sub-Contractors to the Contractor shall not communicate directly with the Project In-charge / Site quality in charge.

J. The QA/QC teams of the Sub-Contractors shall perform their functions directly under the authority of the Contractor's QA/QC Manager.

K. No QA/QC personnel, either of the Contractor or his Sub-Contractors shall take any direction from the Contractor's Site team that works under the authority of the Contractor's Project Construction team.

5.9.2. Quality Control

5.9.2.1. **Section Includes**

Contractor's Quality Control Inspection and Testing requirements.

5.9.2.2. **General**

A. The Contractor's Quality Control resources shall commensurate with the requirements of the Project at any time, including provision for necessary mitigation measures to counter own delays to any direct / sub-contract activity.

B. The Contractor shall ensure that technical documentation are properly produced, reviewed, controlled and submitted in accordance with the Project specific requirements.

C. The Contractor shall ensure that the Work is completed in accordance with the quality requirement and in a safe manner.

D. The Contractor shall provide, in a timely manner, access to the inspection area, instruments to carry out the tests, etc., for inspection of works, as well as copies of relevant submittals to the Project In-charge/ Site quality in charge.
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E. The Contractor shall perform re-testing of materials or system where tests do not meet the project Specification. Any re-testing shall be done by the Contractor at no additional cost to the Owner and any time lost shall be mitigated at his cost.

F. If the Engineer-In-Charge is not satisfied with the quality of any work carried out by the Contractor, the same will have to be redone to meet the required norms as per Specifications. The EIC has the right to withhold part or whole of the amount due for the said job where there is discrepancy in quality and the same will be released only after total compliance.
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G. The Contractor shall arrange for internal and external training as required for their staff to carry out the individual Scope of Works to meet the quality standards required of the Project.

H. The Contractor shall provide for quality control by the employment of skilled and competent management, supervisors and operatives. Only fully compliant Work shall be offered for inspection unless prior written (specific) approval of the Project In-charge and has been obtained and in all such cases, relevant documentation shall be presented during those inspections.

5.9.2.3. **Contractor Quality Control**

A. The Contractor shall provide and maintain an effective Quality Control System that complies with the conditions of the Contract and as further described herein. The Contractor shall be responsible for ensuring that his Sub-Contractors and suppliers conform to the quality requirements as provided in the Contract documents.

B. The Contractor shall establish a “Quality Control” (hereinafter referred to as QC) System to perform sufficient inspection and tests of all items of work, including that of his Sub-Contractors, to ensure construction, finish, functional performance, and identification. This control shall be established for all construction work performed pursuant to the Contract except where the technical provisions of the Contract provide for specific control by inspections, test, or other means. The “Contractor’s Quality Control” (hereinafter referred to as CQC) system shall specifically include the surveillance and tests required in the technical provisions of the specification.

C. The CQC system is the means by which the Contractor assures himself that his construction complies with the requirements of the Drawings and Specification. The control shall include as a minimum at least three phases of inspection for all definable phases of construction as follows:

1. **Preparatory Inspection:** This inspection shall perform prior to beginning any Work on any definable phase of construction and as shown in the Contractor's schedule. it shall include a review of Contract requirements; a check to assure that all materials and /or equipment have been tested, submitted and approved; a check to assure that provisions have been made to provide required control testing; and plan mock-ups when appropriate; examination of work area to ascertain that all preliminary works has been completed; and a physical examination of materials and equipment to assure that they conform to approved shop drawings or submittal data and that all materials and/or equipment are on hand. The Contractor's Representative shall be notified at least twenty four (24) hours in advance of the preparatory inspection and such inspections shall be made a matter of record in the CQC documentation as required by paragraph hereinafter in this section, entitled CQC reports.

2. **Initial Inspection:** This inspection shall be performed as shown in the Contractor's schedule and as soon as a representative portion of the particular phase of construction has been accomplished and the Contractor shall establish the acceptable standard of workmanship, including a review of control testing for compliance with Contract requirements, review of mock-up, use of defective or damaged materials, omissions and dimensional requirements. The Contractor's Representative shall be notified at least two (2) hours in advance of the initial inspection and such inspection shall be made a matter of record in the CQC documentation as required by paragraph "CQC reports" of this section below.

3. **Follow-up Inspection:** These inspections shall be performed daily to assure continuing compliance with Contract requirements, including control testing, until completion of the particular phase of construction. The Contractor shall give a notice period of at least two (2) hours in advance of each inspection. Such inspection shall be made a matter of record in the CQC documentation as required by paragraph "CQC" of this section.

D. The Contractor shall give not less than two (2) hours' notice to Owner before covering up any Work.

E. The Contractor shall, within fourteen (14) days of Letter of Acceptance, report to the Owner, the names and qualifications of personnel assigned full-time to the QC function. The named personnel shall prepare the QC programme and remain as the basis of the QC staff until a QC programme has been submitted and accepted.

F. If any time during the life of the Contract the Project In-charge / Site quality in charge determines the CQC staff is not capable of performing all the tasks listed above, Project In-charge /Site quality in charge notify this to the Owner.

G. The Contractor shall not remove or relocates key staff either within the Site or to somewhere else, without the express approval of the Project In-charge / Site quality in charge.

H. CQC Reports: The Contractor shall submit weekly QC report in triplicate not later than the end of the following Saturday. The report shall contain a record of inspections and tests for all Work accomplished subsequent to the previous report and shall include the following information:

1. Phase(s) of construction underway during the time of frame of the report (i.e. earthwork, concrete work, structural steel erection, etc.).

2. Phase inspection (preparatory, initial, or follow-up), phase of construction and location of inspections and / or tests that were made.

3. Report of test performed, including those specified, with the results of the tests, including failures and remedial action to be taken. Test results, including all computations shall be attached to the report form. Where test results cannot be completed by the time the report is submitted, a notation shall be made that the test was performed and the approximate date test results will be available. Delayed test results shall be submitted with the report form on the date received.

4. Results of inspection of materials and equipment upon arrival at the Site and prior to incorporation into the Work for compliance with submittal approvals, damage and proper storage.

5. Instructions received from the Owner (if any).

6. In all cases, the report must be verified and signed by the one person to whome this responsibility is delegated by the Contractor. The verification is to contain the statement that all supplies and materials incorporated in the Work are in compliance with the terms of the Contract except as noted.

I. The Contractor shall establish and maintain Quality records filing system, which shall include, but not be limited to the following:

1. Quality Control Plan.
2. Inspection and Test Plans.
3. Work and Material Inspection records.
4. Test certificates, Mill certificates, Calibration certificates, etc.

5. Concrete pour records, reinforcement records and structural steel records.
6. Non-Conformance Reports, daily QC reports.
7. Training records, on or off site inspection etc.
8. Identifying the testing laboratories.

J. Laboratories to perform tests shall be approved by the site quality in charge.

K. The Site quality in charge reserves the right to utilize the Contractor's testing laboratory and equipment to make spot tests and to check the Contractor's testing procedures, techniques, and testing results at no additional cost to the Owner.

L. If recurring deficiencies indicate that the CQC system, personnel, inspections, tests and/or records are not providing adequate control, the Contractor shall take corrective action as deemed necessary and directed by the Site quality in-charge. The Contractor shall after receipt of such notice, immediately take corrective action. Such notice, when delivered to the Contractor or his representative at the Site of the Work, shall be deemed sufficient for the purpose. If the Contractor fails or refuses to comply promptly, the Site quality in charge may issue an order stopping all or part of the Work until satisfactory corrective action has been taken. No part of the time lost due to any such stop orders shall be made the subject of time or for excess costs or damage by the Contractor.

M. The Contractor shall notify the Owner / Site quality in charge in writing of any proposed change to the CQC system. No such change shall be implemented prior to concurrence in writing by the Owner / Site quality in charge.

5.9.2.4. **Latest Documents**

The CQC programme shall provide for procedures, which will ensure that the applicable portions of the Contract (and any variations thereto made in accordance with the General / Special Conditions of Contract) and the latest and approved shop drawing and samples are used for fabrication.

5.9.2.5. **Testing and Inspection Devices**

All measuring and testing devices shall be calibrated periodically against certified standard equipment. Copies of certified calibration reports issued by relevant authorities / agencies shall be available for review by the Owner / Site quality in charge.

5.9.2.6. **Test Methods**

A. The tests shall include typical, routine and sample tests specified in Indian standards and /or equivalent international standards relating thereto and

those corresponding to any special requirements or change contained in the Specification. In addition, the Owner / Site quality in-charge may direct special tests to be made to prove that the equipment and materials supplied comply with Specification. The methods of tests for equipment and materials not covered by a recognized standard and for which tests have not been specified herein shall be as directed by Owner / Site quality in charge.

B. Materials shall be tested before leaving the manufacturer's premises as well as after delivery on the Works and the Owner / Site quality in-charge shall be at liberty to reject materials after delivery notwithstanding the preliminary test at the manufacturer's premises.

C. Should the Owner / Site quality in charge and /or Project In-charge decide not to send an inspector to the manufacturer's works, the Contractor shall obtain from the manufacturer's certificates of test, etc., showing that the materials have been tested in accordance with the requirements of the Specification, but the omission of the Owner / Site quality in charge and /or Project In-charge to send an inspector nor the submission of manufacturer's certificates of test as aforesaid shall not relive the Contractor from his contractual responsibilities and commitments or shall affect the right of Owner / Site quality in charge and / or Project In-charge to reject after delivery, materials found to be not suitable or not in accordance with the Specification. The Contractor shall meet all expenses in connection the testing and inspection.

D. Definitions all refer to :

1. "Tests" shall also refer to the inspection and selection of samples.
2. "Point of manufacture" shall include the point of origin or supply.
3. "Samples" shall include mock-ups.

5.9.2.7. **Project Site Samples and Mock-Ups and Testing:**

A. Prepare mock-ups of work required by different sections of Specifications. Remove mock-up not suitable to be incorporated in Work as and when directed by the Owner / Site quality in charge.

B. The Contractor shall initiate mock-ups for typical installations for acceptance of visual and / or performance parameters, prior to progressing with such installations in other areas. These mock-ups are intended to establish quality benchmarks, minimize abortive work and resolve co-ordinations issues. The installation of mock-ups shall supplement the shop drawing and resolve co-ordination drawing requirements and precede the continuous progress of such installations. Such mock-ups can be instructed by the Owner during the course of Work progress, for which no additional cost shall be payable to the Contractor.

C. Contractor shall establish a qualified laboratory to monitor his Quality Control Programme.

5.9.2.8. **Manufacturer's Review**

Contractor and installer shall review the Drawings and Specifications, the shop drawings and product data, with qualified representative(s) of the materials manufacturers for the Project and systems to be used in the Works. The review of the documents and conditions shall confirm that all of the parties are in agreement the selected materials and systems are proper and adequate for the applications shown, especially with respect to compatibility with adjacent systems and materials.

Sl No	Material	Test	Number of Samples
1	Cement : Every 1000 bags consumption or whenever source changes	Compressive Strength	3 Cubes: 7 days
	Strength required: As per IS codes		3 cubes: 28 days
2	Reinforcement: Every consignment	Tensile strength	3 samples for each grade and each diameter of steel
	Independent Testing Lab	Bend tests	
	Results required: As per IS codes	Compressive Strength	7 days – 3 cubes to be tested(Min.)
3	Concrete: Each day minimum 6 cubes for each grade. The frequency of sampling may be as followed:		28 days – 3 cubes to be tested(Min.)
	Cu M no. of samples		
	1-5 1	Compressive strength	
	6-15 2		
	16- 30 3		
	31-50 4		
	51 and above 4 plus 1 additional for each additional 50 m3		Plus additional cubes
	or part thereof.		
	Strength required: As per IS codes		
	1 cube to be cured at site and tested at 7days	Compressive strength	1 cube at site cured
4	Concrete Durability Test: for every 1000 m3	Water penetration test	
	Results required: As per IS codes	Water Absorption test	1 cube for each test
		Rapid chloride penetration test	
		Sulphate content test	
		Chloride content test	
5	Sand: Every day (Site Lab)	Silt content	1 sample
	Results required: Silt content < 5%	Sieve analysis	1 sample
		Moisture Content	1 sample
	Every Week: Independent Test Lab	Silt content	1 sample
		Sieve analysis	1 sample
6	Coarse aggregates: Every day(Site Lab)	Silt content	1 sample

Sl No	Material	Test	Number of Samples
	Results required: Silt content < 3%	Sieve analysis	1 sample
		Moisture Content	1 sample
	Every Week: Independent Test Lab	Silt content	1 sample
		Sieve analysis	1 sample
7	Water: once in 3 months or whenever source changes	Tests on potable of water	1 sample
8	Plastering: Mortar Cubes for every day	Compressive strength	3 cubes
	Minimum required strength : 2.5 n/mm2 at 28 days		
9	Concrete Hollow blocks: Every 1000 blocks	Compressive strength	3 samples
		Water absorption	3 samples
10	Tiles: Every Lot	Compressive strength	3 samples
		Abrasion test	3 samples
		Dimension	3 samples
11	Paint: Every floor	Pull out test	1 sample
		Dry film Thickness	1 sample
12	Waterproofing (Liquid membrane): Every floor	Dry film thickness	3 samples
13	Welding of Structural Steel - Every 100 joints or as specified	Root Bend Test	1 sample
		Particle penetration test	
		Radiography Test	
14	Invert Levels of Slab –Soffits – Every Floor	Deflection Calculations	Every floor
	By 3rd party Surveyors		

SUB-SECTION-X –

5.10. STATUATORY OBLIGATIONS

5.10.1. GOVERNMENT REGULATIONS:

The Contractor shall comply and ensure strict compliance by his employees and representative of all Applicable Laws and undertake to indemnify Owner from and against all levies, damages, penalties and payments whatsoever as may be imposed by reason of any breach or violation of any Applicable Law including but not limited to the claims against Owner, under Workmen Compensation Act 1923, the Employees Provident Fund Act 1952 ("**EPF Act**"), The Contract Labour (Abolition and Regulation) Act 1970, Factories Act 1948, Minimum Wages Act ("**MWA**"), and any labour laws which would be amended / modified or any new act if it comes in force whatsoever, and all actions claim and demand arising there from and/or related thereto.

5.10.2. LABOUR LAWS AND REGULATIONS:

5.10.2.1. The Contractor shall ensure to keep and maintain all the statutory registers, records as required under Applicable Laws including provisions of Contract Labour Act, 1970, MWA and the rules made there under, Employees Provident Fund Act, 1952 and keep the same available at the Site for inspection by Owner's Representatives, and Government Authorities.

5.10.2.2. The Contractor shall ensure that the employee employed by him is paid in accordance with rates specified in the Minimum Wage Act and any changes in statutory wage rates and relevant special allowances are promptly implemented.

5.10.2.3. The Contractor shall ensure that the employees employed shall be covered under provisions of EPF Act and Regulations.

5.10.2.4. The Contractor shall ensure that necessary contribution towards PF is deposited with the authorities concerned and the Contractor shall maintain all the records as per provisions of EPF Act. If the Contractor fails to comply with the EPF Act he shall be exclusively responsible and liable. The Contractor shall ensure that he arranges to deposit professional tax and other fees / amount.

5.10.2.5. Workmen employed by the Contractor shall be directly supervised and controlled by the Contractor or his representatives for Work, discipline and behaviour. The Contractor shall employ responsible representative to be present always at the Site for ensuring proper progress of Work, discipline and behaviour of his workmen and also to ensure not to damage Owner's property, building, machinery and any installations. Additionally, the Contractor shall ensure that the workmen do not carry any inflammable materials like matchbox and film, in prohibited areas.

5.10.2.6. The Contractor shall be solely responsible for the safety of his workmen and to provide them adequate necessary equipment and shall ensure to have all his workmen properly covered under the approved insurance company policies for any injuries and losses to his workmen. Owner shall not be liable for any injury or loss of life of the Contractor's Personnel. The Contractor shall ensure to provide required transport, uniform, safety shoes & safety gadget facilities to his workmen. If the Contractor fails to supply any safety equipment, to his workmen he shall be solely responsible & liable at all times.

5.10.2.7. The Contractor shall ensure that the workers engaged by him are paid regularly and in no way shall Owner be responsible for the salary / emoluments or any dispute under the Applicable Laws.

SECTION: 04
SPECIAL CONDITIONS OF CONTRACT

6. SPECIAL CONDITIONS OF CONTRACT

6.1. DEFINITIONS OF TERMS

In addition to the meanings ascribed to terms in GCC (Section I, Clause 1.1), following terms shall have the meaning as ascribed to such term hereunder. In case any term defined hereunder is also defined in GCC, the meaning described to such terms hereunder shall prevail. Clause 1.2 (*Interpretation*) of the GCC shall be apply, *mutatis mutandis*, to the interpretation of this SCC as well.

"OWNER" shall mean the "M/s. **BIRLA INSTITUTE OF TECHNOLOGY**" their successors and assigns from time to time.

"PERMANENT WORK" shall mean and include Works, which shall be incorporated in, and form a part of the Work to be handed over to the Owner by the Contractor on completion of the Contract.

"CONSTRUCTION EQUIPMENT/PLANT & MACHINERIES" means all appliances / equipments and things whatsoever nature for the use in or for the execution, completion, operation or maintenance of the Work or Temporary Works.

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

"LETTER OF INTENT / LOA" shall mean intimation by a letter / fax to Tenderer(s) that Tender has been accepted in accordance with the provisions contained in the letter.

"EFFECTIVE DATE" shall mean the date on which Contractor's obligations shall commence and that shall be date of acceptance of letter of Intent / LOA. by the Contractor.

"**MOBILISATION**" shall mean establishment of sufficiently adequate infrastructure by the Contractor at SITE comprising of construction equipment, area clearing and grading, excavation, trenching and backfilling, welding equipment, setting up of site offices / camps, establishing manpower organization comprising of resident engineers, supervising personnel and an adequate strength of skilled, semi-skilled and un-skilled workers, who, with the so established infrastructure shall be in position to commence execution of Works at site. "MOBILISATION" shall be considered to have been achieved, if the Contractor is able to establish infrastructure as indicated above to begin Work at site.

6.2. PRECEDENCE OF DOCUMENTS

In the event of conflict between various drawings / documents forming part of this Contract, the precedence of documents shall be as set out in the Formal Instrument of Agreement.

6.3. SCOPE OF WORK

The Scope of Work will specify the functional aspect of the building under construction (for instance, office building / food court /multi-level car parking) along with the number of floors being considered in each structure.

The activities to be carried out for the abovementioned structures will be as mentioned in the Bill of Quantities including excavation back filling, anti-termite, plain cement concrete, plum concrete, RCC, masonry, plaster, flooring and other civil /structural/plumbing work at the Site.

6.4. NATURE OF CONTRACT

i. The Contract is item rate Contract. The total amount payable to the Contractor by the OWNER shall be the sum ascertained by multiplying the measured quantity of each section or item of Work actually carried out under the Contract by the rate shown in the Schedule of Rates (as provided in Schedule A) for item and lump sum wherever indicated separately for some items.

   The Schedule of Rates shall be deemed all-inclusive. The rates shall be firm and fixed during the Contract Period and shall not be subject to any change whatsoever.

ii. The Schedule of Rates shall be read in conjunction with SCC, GCC, Specifications, Drawings, and any other documents forming part of the Contract Documents. The quantities shown against various items are only approximate and subject to variations as mentioned elsewhere in the document.

iii. The OWNER reserves the right to interpolate/extrapolates the rates for any new item of work not covered in the Schedule of Rates. All the schedule items shall be measured upon completion and paid for at the contracted rates. In case any activity is not specifically covered in Schedule of Rates, but is required to be performed for completion of the Work, the OWNER or its nominated representative in consultation with the Engineer-In-Charge shall mutually agree to the quantum of resources that would be required in doing the job by the Contractor and accordingly determine the price of such works, which shall be binding on the Contractor.

iv. All Works covered under a particular item in the Schedule of Rates shall be constructed and performed as per the Specifications, Drawings and instructions of Engineer-In-Charge and the rates so quoted in the Schedule of Rates shall be inclusive of all materials, consumables, labour, supervision, tools and tackles, Taxes, licences, fees, profit and overheads as well as any preparatory works.

6.5. PAYMENT TERMS.

6.5.1. Running Account Bill.

i. Contractor shall submit Running Account Bill generally (unless otherwise specified) once in a month with all supporting documents as mentioned in Clause 1.5.2. Further, the Owner may request and the Contractor shall be required to submit, such additional documents as may be required for certification of the R.A. Bill.

ii. No ad hock / advance payment against R A Bill shall be paid.

iii. The Contractor shall not be permitted to claim any amounts in excess of the rates specified against such item in the Schedule of Rates.

iv. Checking and certification of each R A Bill shall be made by the Owner's consultants / Owner within 15 days of submission subject to submission of proper documentation (as specified in Sub-Clause (i) above) with the bill. R.A. Bill. The Owner may summarily reject the R.A. Bill if any of the stipulated documents (or any other documents as requested by the Owner) are found missing or incorrect.

v. Payment of R.A. Bill shall be made within 30 days from the date of certification by the Owner or consultant pursuant to Sub-Clause (iii) above.

6.5.2. Following documents shall be submitted along with each R A Bill:

a) Joint measurements book of all hidden work including bar bending schedule of reinforcement steel.

b) Hard copy of electronically generated measurement sheet with detail measurement of each work & soft copies of the bill.

c) Receipt / invoice of materials supplied by the Owner along with Reconciliation Statement for the material supplied by the Owner.

d) Quality compliance certificate with status from the designated personnel of the Owner in charge of quality control.

e) Safety compliance certificate with status from the designated personnel of the Owner safety in charge.

f) Updated status of non-compliance reports issued by the designated representative of the Owner under Sub-Clauses (d) and (e) above, along with details of remedial action taken by the Contract ("Action Taken Report").

g) Monthly and weekly target and achieved programme and progress report duly signed and approved.

h) Statement of variation in quantities with respect to the BOQ if any, mentioning reasons thereof and future expected variation in the particular items.

i) In case of extra item of work, analysis of rate, total quantity of work of the specific item with all supporting documents (as specified in Clause 1.5.2 above and instruction of work, relevant drawing, bill / invoices). However payment of amounts towards additional or extra works shall to subject to approval of the EIC.

j) In case work is executed beyond the Contract Period, approval of Extension of Time shall be submitted.

k) Reconciliation Statement for the material supplied by the Owner.

l) Details of all Test Certificates for materials used, standard deviation, target mean strength achieved and such other documents as may be requested by the Owner are required, to be submitted by the Contractor.

m) Deposit certificate / slip of GST of the previous payment.

n) Copies of insurance and bank guarantee as and when asked for.

o) Submittals on labour compliance as per applicable labour laws.

p) Concrete requisition slip/concreter starting slip/survey check report/pre and post pour card/concrete delivery ticket.

6.5.3. Completion Drawings

The Contractor shall prepare and submit to the Owner three sets of "AS BUILT" Drawings [and reproducible of same], as approved by the relevant Governmental Authorities. Provided that, prior to obtaining the approval of the relevant Governmental Authorities under this Clause 1.5.3, the Contractor shall submit to the Owner (or such consultants of the Owner as the Owner may direct) copies of the "As Built" Drawings for its approval. If the Owner is of the opinion that the "As Built" Drawings are incomplete, inaccurate or in a form not acceptable, the Contractor shall be required to make such revisions, as may be directed by the Owner or its consultant, prior to submitting the same for approval of the relevant Governmental Authority.

The "AS BUILT" Drawings and reproducible shall show the layout of cables, pipes and ducts. both within the building and outside, in case these items are included in the scope of the Contract and the drawings shall be [reproducible].

6.5.4. Final Bill.

i. Within forty five (45) days of the Contractor completing all Works under the Contract and obtaining the Virtual Completion Certificate, the Contractor shall submit the final bill with all relevant / applicable supporting documents as mentioned above with three set of "As Built" Drawings. The Final Bill shall be deemed to be final, conclusive and binding on the Contractor once submitted and accepted by the Owner. The Contractor shall in no event revise or modify the Final Bill without prior written consent of the Owner and no further claims raised by the Contractor shall be allowed or entertained or considered by the Owner.

ii. The Contractor shall submit to the Owner, together with the Final Bill, all documents required for Virtual Completion Certificate as mentioned in Clause 32 of Section IV of the GCC.

iii. No ad hock / advance payment against Final Bill shall be paid.

iv. Checking and certification of the Final Bill shall be made by the Owner or its consultants within sixty (60) days of submission by the Contractor, subject to the all necessary documentation (as specified in the Clause 1.5.4 or as may be requested otherwise by the Owner) together with the Final Bill.

v. Payment of Final Bill shall be made within Thirty (30) days from the date of certification of the Final Bill by Owner or its consultants.

6.5.5. Power to with hold payment by Owner.

Owner shall have the right to withhold and adjust against any dues of the Contactor under the Contract Documents, any payments to be made to the Contactor under an R A Bill (in full or in parts) for the reason of any material non-compliance with the terms of the Contract Documents including any deficiency in quality of Works, delays in progress of Works, as per the discretion of EIC.

Such withholding of payment shall neither relieve the Contractor from any of its obligations under the Contract including the execution of the Works with due diligence and in accordance with the Time Schedule, nor entitle Contractor to claim any additional costs including interest or loss of anticipated profit.

6.5.6. Indebtedness

The Owner may withhold any money due to the Contractor for clearing indebtedness of the Contractor to the Contractor's Personnel.

6.6. COMPUTERISED BILLING SYSTEM

Without prejudice to Clause under heading "PROCEDURE FOR MEASUREMENT / BILLING OF WORK IN PROGRESS" of Section V of the General Conditions, the Contractor shall prepare the invoices / bills in the formats desired in the electronic media. However, only the hard copies of these bills shall be forwarded in desired numbers to the Engineer-In-Charge for verification, certification and onward transmission / distribution of invoices for processing and subsequent release of payments.

However all hidden type measurements shall be recorded jointly in the Measurement Book. In case of failure to record joint measurement, measurement assed by the Owner shall be deemed as final and binding.

6.7. EXTRA ITEMS

Rates for authorized extra items i.e. items approved by EIC or additional, altered or substituted work as may be ordered by the Owner shall be determined by the EIC/Architect as follows:

i. At the rate of a similar quoted item, as provided in the Schedule of Rates; or

ii. At the actual expenditure incurred in execution of the item inclusive of any Taxes plus agreed percentage for Contractor's profit and overhead. The actual expenditure shall be determined basis the materials and labour utilized in execution of the Works, as per the Schedule of Rates.

iii. Cost of plant, machinery, and vehicle in terms of hire charges or depreciation shall be considered as the part of overhead unless the same is specifically bought / used at Site for the purpose of executing the particular items/ items only.

6.8. Owner's supply materials

Owner's supply materials on free-issue basis with Monthly Reconciliation to be submitted along with each RA Bill:

- Reinforcement Steel & PT & Anchor strands.
- Structural steel
- Ready Mix Concrete.
- Tiles/Granites/Marbles.
- Cement

6.8.1. In case Owner is unable to supply material mentioned as above, Owner may ask the Contractor to procure the material with prior approval from EIC.

a) Contractor shall procure all materials to be supplied by it in accordance with the procurement guidelines furnished by the Owner from time to time. Contractor shall procure materials of a reputed make and bearing ISI stamp. All purchases of materials shall be made only from registered Governmental Authorities in relation to payment of applicable Taxes.

b) Contractor shall ensure timely delivery of all materials at Site to ensure execution and performance of the Work in accordance with the Programme Schedule and in such quantities as may be required to fully perform its obligations under the Contract.

c) Contractor shall make his own arrangement for all the materials required for enabling execution of the Work.

6.8.2. Permissible Allowances of wastage.

The percentage allowances shall be accounted for on the basis of the below:

Item	Wastage Limit
Reinforcement Steel	3.0%
RMC	2.0%
Structural Steel	5.0%

In case of wastage beyond the permissible limit as mentioned above, the same shall be recovered from Contractor's R.A. Bill/ Final Bill .

6.9. RETENTION MONEY

The Owner shall, out of the amounts payable to the Contractor under an R.A. Bill or the Final Bill, retain an aggregate amount of 5% of the total amount to be paid to the Contractor out of which 2.5% can be released against submission of equivalent bank guarantee obtained from nationalised bank and balance 2.5% cash retention from Running Account Bill. Alternatively, the total retained amount shall be released by the Owner upon issue of the Final Completion Certificate by the Engineer-In-Charge against submission of a single bank guarantee of an equivalent value from nationalised bank, by the Contractor, valid up to end of the Defects Liability Period for all the Works.

6.10. PERIOD OF COMPLETION OF WORK

6.10.1. Period for construction and scope of work as detailed in the Tender Documents which is inclusive of monsoon period from date of start of project (inclusive of mobilisation period).

6.10.2. The successful tenderer shall furnish detailed programme of works (M.S. Project) to the Owner after the final round of discussion and before getting the Letter of Intent/Work Order.

6.10.3. The programme so submitted shall be well co-ordinated with details of mobilisation of men/material, catch-up schedule if any and the stage wise payment schedule based on the agreed Master Construction Programme.

6.10.4. The accepted Master Construction Programme shall be the basis for evaluation of rate of progress.

6.11. EXTENSION OF TIME FOR COMPLETION

In the event the Contractor is of the opinion that for events/reasons not attributable to the Contractor extension of time for completion of the works may be required, the Contractor shall notify the Owner in writing thirty (30) days prior to the expiry of the Contract Period (i.e. Twenty Two (22) months) of such events/reasons and seek extension of time. The extension of time may be granted without assigning any reason what so ever at the discretion of the Engineer-In-Charge and shall be without prejudice to the Owner's right to claim Liquidated Damages as specified hereinabove.

It shall be abundantly clear that granting extension of time is the absolute discretion of the Owner/EIC. No claims of any nature shall be payable to contractor against approval of extension of time for any reason what so ever.

However, small changes in Drawings, revisions in Drawings, issuance of any sketch with detailing, small and minor change in decision, small and minor Holds, occasional non availability of some work fronts, ordering of work in piece meal manner, minor delay in handing over site of work, occasional delay in Owners supply of materials or minor shortage of owners supply material etc shall not constitute sufficient ground for delay in work by claiming extension of time. Delay causing actual impediment in work for a considerable period of time as per the discretion of EIC shall be considered for extension of time. It shall be clearly understood under the contract that the Contractor shall endeavour their best to make good the delay by deploying extra resources and shall do all as per the requirement and satisfaction of the owner to proceed with the work by covering up such delay. For doing so, no claim or compensation shall be payable to contractor.

6.12. SUSPENSION OF WORKS.

No compensation against idling of man, power and machinery is payable if the work is got suspended due to reason beyond the control of Owner such as clearance / hold by Local/State/ Central Government. However, in case of suspension for the whole work beyond the period of consecutive 30 days, idling against manpower and machinery shall be paid to the Contractor. Amount of such compensation shall be decided by the EIC and such decision shall be binding to the Contractor. Suspension upto a period of consecutive 30 days, no compensation of any kind shall be payable to the Contractor.

6.13. INSURANCE OF THE WORKS

i. The Contractor shall provide insurance cover for his personnel and any plant and equipment deployed by the Contractor in the execution of the Works. Insurance for personnel should include workers compensation personnel accident and all medical claims.

ii. Owner shall take property and surrounding property insurance including Third Party Insurance (TPI) for Owners representative and their workmen. All other insurance regarding Contractors equipment, machineries their Contractor's Personnel shall be under Contractor's scope.

6.14. PROVISION OF SITE SERVICES AND FACILITIES

For the purposes of the Contract, notwithstanding relevant Sub-Clauses of Section II of the General Conditions of Contract, following provisions shall apply.

6.14.1. Construction Water & Drinking Water

Construction & Drinking water: - Contractor shall arrange water for construction and make necessary arrangements at his own cost for storage, installation, operation, maintenances and dismantling of the distribution system.

6.14.2. Power Supply

Power connection and supply for the entire construction and other allied facilities shall be under the scope of the Contractor.

However if the Owner provides power supply, the same shall be charged as per the actuals at per rate of local board tariffs. The Owner shall provide the same within the premises at one point only. Further distribution and removal on completion of project shall be done by contractor at his cost. The cost towards consumed electricity shall be recovered from the Contractor's Running Account Bill as per actual rate. In case of breakdown or stoppage in between, contractor has to arrange stand by arrangement. No claim shall be entertained in this respect. Any shortage of supply from the main sources shall not be considered as sufficient cause of any delay of work and / or any claim there of. Contractor shall be equipped with all necessary alternative arrangements to counter such shortage of supply.

Contractor shall provide at his own cost all 240 general purpose outlets and shall be protected by sensitive current balance earth leakage protection equipment. The ENGINEER-IN-CHARGE shall require the disconnection or alteration of any part which is considered dangerous.

6.14.3. Sanitation & Drainage during Construction:

The Contractor shall provide sanitation and drainage facilities on the site as stated. hereunder :

The Contractor shall strictly control the labour so that the site is not polluted, made dirty or littered with debris, wastes or the likes.

Any person found creating mess or litter or pollution shall be removed from the Site immediately at the Contractor's cost.

The Contractor shall provide sanitation facilities at convenient locations on site to preserve the cleanliness of the site. The effluent shall be directed as follows:

Waste water: Collection and pumping out and disposal off the site in an approved manner.

Sewage: Should establish a STP provision for sewage generated during construction.

The location of the above provisions shall be as marked on the site mobilisation scheme drawing.

6.14.4. LAND / SPACE FOR CONSTRUCTION SITE ESTABLISHMENT

To the extent possible, Owner shall provide necessary space for the Contractor to set up its office at the Site, if not, then Contractor has to make alternate arrangement, and also if shifting is required because of Site condition the same has to be done by Contractor without any additional cost to Owner.

6.15. SPACE FOR LABOUR COLONY:

Shall not be provided by the Owner.

6.16. MEETINGS

i. Meetings shall be convened weekly or at other intervals as deemed necessary by the Engineer-In-Charge during the Contract Period and such meetings shall be held on Site during the period of Site work. The meetings shall be attended by the senior Representatives of both OWNER and the Contractor.

ii. The meetings shall ascertain Work progress, safety issues, any problems related to manpower, equipment or Site conditions, and provide early notice of any potential claims for Variations. Meetings shall be minutes by the OWNER Representative / Engineer-In-Charge. Copies of the minutes shall be supplied to attendees and a standard list of addressees and the OWNER.

6.17. LOGISTICS PLAN

Once the Master Construction Programme has been approved, the Contractor should submit a detailed Logistics Plan for approval, clearly defining the locations of all heavy

equipment, movement of men and machinery, details of stock-yards for every quarter of the period of construction.

6.18. PROGRESS AND MANPOWER REPORTING

a) The Contractor shall file daily category-wise labour return. The report shall indicate scheduled requirement against actual strength of each category.

b) The Contractor shall prepare weekly reports of planned and actual progress of work and subsequent week's scheduled work. These will also include material procurement status. These reports shall be submitted to Owner and shall be reviewed in weekly co-ordination meeting.

c) The Contractor shall submit monthly report along with monthly bills.

d) Further, progress charts and schedules shall be prepared by the Contractor as directed by the Owner.

e) The Contractor shall submit re-conciliation statement of all the materials supplied by the Owner, along with every running bill.

f) The Contractor shall submit concrete pour card in relation to the Works.

g) Method statement along with checklists for all activities included in the Bill of Quantities for the approval of the Owner shall be submitted by the Contractor within such time as to ensure that the relevant approvals are obtained well before the commencement of the said activities at Site without hampering the progress of Works.

6.19. KEY PERSONNEL

i. Further to Clause under heading "CONTRACTOR'S REPRESENTATIVE, SUBORDINATE STAFF AND THEIR CONDUCT" of Section III of the General Conditions, the Contractor shall designate the key personnel of the Contractor with respect to the Works to be carried out under the Contract. Such key personnel shall not be substituted without the consent of Engineer-In-Charge.

ii. The key personnel so nominated shall be competent and shall have the necessary skills for their position and for the performance the Work to which they are assigned.

iii. Where for reasons outside the control of the Contractor any of the nominated key personnel are unable to continue in their assigned position, the Contractor shall immediately:

- Notify the Engineer-In-Charge; and

- If so requested by the Engineer-In-Charge, arrange for a replacement of that person with a person satisfactory to the Engineer-In-Charge (who shall become one of the nominated key personnel) at no cost to the OWNER.

6.20. PERFORMANCE OF WORK

The Contractor shall endeavour to undertake the Work on continuous basis, with extended daily and night shifts. The Contractor shall provide adequate lighting masts to ensure satisfactory working whenever working at night is undertaken. Rates quoted by the Tenderer shall take this aspect in to consideration and no extra claims shall be entertained by the OWNER on this account.

6.21. MINIMUM PLANTS & MACHINERIES

i. Contractor is to provide list of minimum plant & machineries for their scope of work.

ii. If the actual requirement of plant & machineries exceeds those listed during tendering (min required at the time of deployment) the same shall be deployed for the execution of the work with in the time schedule and as may be required under the Contract by OWNER at no extra cost to OWNER.

iii. The Contractor's plants and equipments shall be of first class standard, fit for purpose and shall comply with the requirements of any statute, statutory regulation or direction of any body having jurisdiction in the matter relating to the maintenance, use, operation or safety features of the same. In the event that the Engineer-In-Charge considers any of the Contractor's materials plant and equipment to be dangerous or in contravention of any said statute, statutory regulation or direction and if the Engineer-In-Charge for that reason directs that the same shall be removed from the Site and replaced with an alternative, the Contractor shall at his cost comply with such direction notwithstanding that the Engineer-In-Charge may previously have approved the same.

6.22. DRAWINGS SUPPLIED BY THE OWNER

i. The Drawings accompanying the Tender are indicative in nature and issued for tendering purpose only. Purpose of these Drawings is to enable the prospective bidders to make an offer in line with the requirements and Scope Of Work and other requirement as defined in the Tender. However, no change in rate what so ever shall be entertained for Variation.

ii. Regarding any changes, construction shall be as per the Drawings and Specifications issued and approved by Engineer-In-Charge / Owner during the course of execution of Work. Detailed construction drawings on the basis of which actual execution of Works is to proceed shall be furnished to the

Contractor progressively based on the Programme Schedule evolved after the award of the Work as per instruction of the Engineer-In-Charge, job requirement and also based on Time Schedule targeted to be achieved.

iii. Copies of all detailed working drawings relating to the works shall be kept at the Contractor's site office and shall be made available to the Engineer-In-Charge / Owner at any time during execution of the Contract. However no change in rate whatsoever shall be entertained for Variation.

iv. Drawings and decision shall be issued as and when required depending on the requirements and urgency of the Owner and availability of the space of work. Any delay in Time Shcedule shall not be considered and no idling of resources shall be payable.

6.23. DETAILS TO BE CONFIDENTIAL

The Contractor shall not disclose details of drawings furnished to him and works on which he is engaged without the prior approval of the Owner. No photograph of the works or any part thereof shall be taken except for the purpose herein stated, or permitted by the Contractor to be taken without the approval of the Owner.

6.24. TAXES AND DUTIES

In addition to the terms of General Conditions of Contract of relevant Clause under heading "TAXES AND DUTIES":

i. All Taxes and duties fees, charges and expenses, except where otherwise expressly provided in the Contract, as may be levied/imposed in consequence of execution of the works or in relation thereto or in connection therewith as per Applicable Law shall be to Contractor's accounts if included in the Contract Price or else shall be paid extra wherever applicable.

ii. The Tender Sums should include all applicable Taxes wherever specified or shall be paid extra based on terms of the Purchase Order (including GST).

6.25. VARIATION OF QUANTITIES IN BOQ AND PRICES.

Quantities shown in the BOQ are approximate and tentative. Thus variation in quantities shall be any extent for individual items and prices. No changes and higher revision in rate shall be considered for payment due to variation in quantity given in BOQ under specified Scope Of Work. However, Scope of Work as described in the Contract in broad shall be subject to variation limit of +/- 20% in over all Contract Price and not in individual items. In case the scope of work varied beyond this limit, revision of rate may be considered through mutual agreement by the Parties. However final decision shall be as per the discretion of EIC and binding to the contractor.

The Owner reserves the right to get the specialized works for instance, water proofing post tensioning and executed by a separate agency. The main Contractor shall however do all the necessary co-ordination and agreed co-ordination charges shall be paid for the same For doing so any Variation in the Contract Price shall not be considered for calculation of the variation limit as mentioned above**.**

6.26. ESCALATION / VARIATION IN RATE AND PRICES

This is a firm rate contract and escalation in rate or prices is not applicable save and except under the circumstances beyond the control of the Contractor. Even in case Contract Period is extended, rate for item of work shall be same, unless with the consent of the Owner. It shall be abundantly clear that in case of any delay for any reason whatsoever only Extension of Time may be allowed in accordance with the terms of the Contract Documents, with out any upward revision in rate.

6.27. REGISTRATION OF THE CONTRACT WITH STATUTORY AUTHORITIES

Within 30 days of the signing of the Contract, the Contractor shall register themselves and the Contract at their own cost with Reserve Bank of India, Income Tax and such other Governmental Authority, as may be required under Applicable Law. The Contract Price shall be deemed to include all costs towards the same. A copy of all documents related to all such registration shall be submitted to OWNER for record.

6.28. TEMPORARY WORKS

All temporary and ancillary works including enabling works connected with the Work shall be responsibility of the Contractor and the price quoted by them shall be deemed to have included the cost of such Works which shall be removed by the Contractor at his cost immediately after completion of the Work.

6.29. COMMENCEMENT ON SITE

Notwithstanding the relevant Clause of the General Conditions, the Contractor shall give to the Engineer-In-Charge at least seven days notice in writing of its intention to commence Work on the Site. Work in any area of the Site shall commence only when authorized by the Engineer-In-Charge.

6.30. CONDITIONS OF ENTRY TO SITE

All Persons working on or visiting the SITE shall be identified as being employed by, or responsible to, the CONTRACTOR.

The CONTRACTOR and the Contractor’s Personnel shall comply with the requirements of the ENGINEER-IN-CHARGE as regards entering and leaving the SITE.

The CONTRACTOR shall ensure that all vehicular traffic is confined to existing access roads and tracks or to access roads and tracks constructed specifically for the purpose

of carrying out the WORK. Every effort shall be made to ensure that dust-raising is kept to a minimum especially in areas close to residences, camps and active work areas. The CONTRACTOR shall impose speed limits, utilise water spraying or carry out any other dust-reducing activities as the ENGINEER-IN-CHARGE may deem reasonably necessary to control dust.

The CONTRACTOR shall ensure that all plant, equipment and vehicles have been cleaned to prevent the transfer of noxious weeds.

The CONTRACTOR shall provide to all its workers/employees the following minimum personal protective equipment prior to their entry to the SITE:

a. Safety Helmet (To authorised Visitors also)

b. Safety footwear

c. Safety glasses

d. Hand Gloves to labourers

e. Cotton clothing including long sleeves in Hot Work area

The Contractor to erect Safety Net(s) at all working areas as per the proper guidelines of EIC

The OWNER accepts no responsibility for the loss of, or damage to, the Contractor's or the Contractor's Personnel's vehicles, tools, clothing and other equipments. Each item of plant or equipments shall bear a suitable identification mark of ownership.

All vehicles entering or leaving the SITE shall be subject to inspection of both the vehicle and its contents. The drivers of all the vehicles to be trained to follow all traffic rules while plying either inside or outside the plant premises.

All containers include personal bags, cases and the like being brought onto or taken from the SITE, shall be subject to inspection.

The Contractor should construct a weatherproof cement go-down of minimum storage capacity of 2000 bags at his cost and the space for the same shall be provided by the Owner. Go-down will have to be demolished by the Contractor at his own cost and cleared after work is completed.

6.31. FORMWORK & SCAFFOLDS:

a. Wooden ballies SHALL NOT BE USED for props/scaffolds.

b. For centering/shuttering/formwork, steel adjustables props/beam span, steel plates/floor form and PLASTIC COATED PLYWOOD only are to be used.

c. Formwork for columns, beams and walls shall be out of plastic coated plywood or as per agreed standards.

d. Scaffolds for finishing work such as plastering/ painting/working at heights shall be out of steel tubular H-Frames with proper steel working platforms.

6.32. The Contractor shall give an indent to the Owner for the procurement of cement in advance, considering the lead time required for the procurement. The Owner will supply ordinary portland cement at basic price (landed price at site). However, if the Owner directs the Contractor, he will have to procure the cement of the brand as approved by the Owner and difference in cost will be to the Owner's account. Empty bags (good condition) shall be returned to Owner and it will be the property of the Owner.

6.33. The quoted rates shall include for the wastages on cement and the recovery shall be for actual quantity supplied to the Contractor as follows:-

a) Upto the wastage limit of 3% of the theoretical consumption at the agreed basic rate per bag.

b) Beyond the wastage limit of 3% of the theoretical consumption at the landed rate per bag .

6.34. The Owner will supply reinforcement steel to the Contractor free of cost in available length and sections in the market, either in straight length, bent form or coil form.

6.35. The Contractor shall give an indent to the Owner for the procurement of steel in advance, considering the lead time required for the procurement, and in available lengths and sections in the markets.

6.36. The Contractor has to record the actual unit weight of steel of all the diameter jointly with the Owner's Representative for each consignment supplied by the Owner, to assess the rolling margin, by taking average of 3 samples of each diameter and submit to the Owner within 30 days after the supply.

6.37. The Contractor has to give the reconciliation of steel (diameter-wise) supplied by the Owner in every R.A. Bill.

6.38. 3 % wastage shall be allowed for the reinforcement steel and PT strands supplied by the Owner except for the rolling margin if any. The quantity in excess of the billed quantity shall be recovered from the Contractor at agreed landed rates;

6.39. The rate quoted shall include the following for the fabrication of reinforcement steel:

a) Providing and fixing of concrete cover blocks.

b) Providing spacer bars, pins, chairs etc., and unauthorised laps.

c) Cutting, bending, placing and fixing in position

d) Providing and tieing binding wire

e) Cleaning of bars

f) Unloading from lorry, handling from stores and leading of placement.

g) Restacking of steel from House Keeping point of view.

h) Straightening of bars either from bent form or coil form

The work shall be measured considering the theoretical unit weights of reinforcement steel as mentioned in the Specifications. The variation due to rolling margin shall be considered only for the reconciliation of steel and not for measurement/payment. The material consumed for spacer bars, pins, chairs and unauthorised laps shall not be taken for measurement and for reconciliation purpose. unless otherwise specified in Purchase Orders.

The Contractor's Representatives shall be available for noting the weight of steel at Weigh Bridge as and when required at his cost and acknowledge the same.

6.40. All the surplus material indented by Contractor and supplied by Owner shall be recovered from the Contractor at the rates at agreed basic rates.

6.41. The Contractor shall indent for the materials (which have to be supplied by the Owner free of cost, and other than steel and cement which are as detailed above) well in advance considering the lead time required for the supply. The Contractor to give proper reconciliation of materials supplied by the Owner.

6.42. The materials supplied to the Contractor beyond wastage limit as specified below will be recovered from the Contractor at the rates at which these excess quantities were procured by the Owner.

Ceramic / Vitrified Tile	-Three -percent
Marble Tile / Slab	-Ten-percent
Granite Tile / Slab	-Ten percent
RMC	-Five percent.
PT strands	-Three percent.

Extra wastage over and above the above allowable percentages shall be recovered at the landed cost of the material at site.

6.43. ADHERENCE OF GOVERNMENT RULES AND REGULATION.

The Contractor agrees to and does hereby accept full and exclusive liability for the payment of any and all Taxes now or hereafter imposed, increased, or modified from time to time in respect of works and materials and all contributions including as may be applicable to unemployment compensation, insurance and old age pensions or annuities now or hereafter imposed by any Governmental Authority, or other compensations payable to the Persons employed by the Contractor and the Contractor shall be responsible for the compliance with all obligations and restrictions imposed by the labour laws or any other Applicable Laws affecting Owner-employee relationship and the Contractor further agrees to comply, and to secure the compliance of all Sub-Contractors, with all Applicable Laws. Contractor further agrees to defend, indemnify and hold harmless from any liability or penalty which may be imposed by the any Governmental Authority by reason of any violation by Contractor or Contractor's Personnel of such Applicable Laws and also from all claims, suits or proceedings that may be brought against the Owner arising under, growing out of, or by reason of the performance of the Contractor of its obligations under the Contract, by any Governmental Authority. For the avoidance of doubt it is clarified that the Persons employed by the Contractor (including the Contractor's Personnel) shall in no event be deemed to be employed by the Owner. The Owner shall be indemnified by the Contractor against any and all such claims that may arise in this regards.

6.44. ENVIRONMENTAL PROTECTION

i. General

The Contractor shall comply with the requirements of the Environmental Management Plan duly approved by Owner.

ii. Protection of Property

The Contractor shall ensure that all employees exercise care when working in the vicinity of livestock. In the event of livestock injury or loss, no matter what the cause, the incident shall be reported immediately to the ENGINEER-IN-CHARGE. Should the loss be directly attributable to the actions of the CONTRACTOR or the Contractor's Personnel, full compensation shall be made directly to the owner by the CONTRACTOR at the Contractor's own cost.

iii. Carrying Firearms, Traps and Other Fauna-Taking Equipment

The CONTRACTOR shall advise all employees in writing and ensure that firearms, traps or other fauna-taking equipment are prohibited at all times in all areas of the Site, or in work vehicles.

iv. Preservation of Flora and Fauna

a. The CONTRACTOR shall refrain from destroying, removing or clearing trees, timber and scrub to an extent greater than is necessary for the execution of the WORK.

b. The CONTRACTOR shall ensure that all employees refrain from hunting, disturbing or capturing fauna within any area or illegally taking fish from any water.

c. The CONTRACTOR shall exercise all proper care to preserve the vegetation, flora, fauna and other natural resources or assets of any area in which WORK is being performed or in any adjacent areas.

d. The CONTRACTOR shall take such measures as may be necessary to prevent any employees from taking any protected flora or fauna as may be declared under Legislation.

v. Fencing

a. The CONTRACTOR shall avoid fence damage or cutting of fences wherever possible. All temporary or damaged sections of fencing shall be properly restored by the CONTRACTOR with new materials of similar type to those used in the existing fence, to the satisfaction of the ENGINEER-IN-CHARGE.

b. The CONTRACTOR shall take all precautions to prevent movement of stock through damaged sections of fencing.

vi. Pets

The CONTRACTOR shall ensure all employees refrain from keeping pets of any type in the area of the SITE, construction camp or vehicles.

vii. Disposal of Waste Fuel, Lubricants and Hazardous Chemicals

a. The CONTRACTOR shall remove from SITE and dispose of all waste fuel, lubricants, drilling fluids, chemicals and other such substances in a safe and environmentally friendly manner.

b. This requirement is subject to compliance with any recommendations by the substance manufacturers and legislative requirements and subsequent approvals regarding safe disposal.

c. In case of any hazardous waste, the same shall be discharged through authorised agency of the relevant government department.

6.45. Schedule of Materials

The rates quoted by the contractor shall be **inclusive of the cost of cement, reinforcement steel, and structural steel**, with basic rates finalized as per the terms of the contract.

The contractor shall be fully responsible for the **unloading, handling, storage, safe custody, and proper accounting** of all materials. All required **testing and quality checks** shall also be carried out by the contractor at his own cost.

At every stage of the work, and upon completion, the contractor must submit a **detailed reconciliation statement** for cement, reinforcement steel, and structural steel.

For the purpose of this contract, the **entire Discovery Village premises shall be considered as a single site**. No additional payment shall be made towards **shifting of materials, internal transfers, or disposal of debris** within the site.

6.46. Mobilization Advance

Mobilization advances up to maximum of amount as mentioned in the NIT, shall be paid to the contractor, if requested by him, on submission of irrevocable Bank Guarantee valid for the contract period of an amount of 10% of contract value as decided by the client. The mobilization advance will be no interest bearing and will be deducted from every corresponding RA bills @ 10% of the bill value, as per the schedule mentioned in schedule of payments.

The advances shall be paid in three installments as follows:

1. 1st installment of not more than fifty percent of total mobilization advance shall be paid after the agreement is signed and upon submission of performance guarantee for full amount as specified.
2. 2nd Installment of not more than fifty percent of total mobilization advance shall be paid on mobilization of man, material & machinery, site office and start of excavation work and after the contractor has fully mobilized the work force at site.

The bank guarantee submitted by contractor against mobilization advance shall be initially to be made of the amount equivalent to the amount of each installment as mentioned in 1st & 2nd points of clause 5.2. and valid for the period of 10 months from the date of payment to the end of 10 months corresponding date, both the dates to be inclusive on the outstanding amount of advance.

Note: Bank Guarantee is only required on demand from the client.

6.47. Supply of certain materials by the client

Materials (if Certain materials) shall be supplied by the client. Materials shall be transported to inside the site. Main entry gate shall be considered the point of delivery to the contractor. Unloading of materials from the trucks/lorries, carriage to stores/go down and/or location of use, safe storage, stacking etc. shall be the responsibility, strictly and singularly of the contractor. In no case any extra charges will be entertained on this account. The contractor shall maintain an inward and outward register and get it signed by the Engineer In-charge or Client on a weekly basis.

6.48. Testing of Cement / Steel

For the supply of materials by Contractor, it shall be contractor's duty to arrange for the test samples of cement & steel for every separate consignment that shall be received by the contractor at site or as directed by the Site Engineer. Contractor will not be reimbursed the amount of such bills of test reports carried out at recognized technical institutes or

laboratories. Other sundry expenditure like transport, handing over of samples, packing and getting test results, even by deputing his personnel will be borne by the contractor.

Laboratory: Contractor shall set up a laboratory at the site or get the testing from a government approved laboratory with proper size with following apparatus to facilitate the testing of material and concrete, etc., and the same shall be maintained in working condition at site throughout the construction work and shall be made available to engineers in charge for spot testing.

Instruments to be kept in laboratory shall be as follows:

1. Steel Tapes – 3M, 10M, 15M, 30M (White clad spring held)
2. A good quality plumb bob.
3. Hand level – 30cm. along with 3 bubbles – can be used for horizontal as well as vertical surfaces.
4. Wire gauge (B.W.G. of S.W.G.)
5. Foot rule (rigid)
6. Long Nylon thread
7. Rebound hammer with Calibration chart for Testing Concrete.
8. Right Angle (Steel)
9. Hydraulic concrete cube testing machine (100 T).
10. Set of I. S. Sieves
11. Leveling instruments including theodolite.
12. Measuring jar for sand testing
13. Slump Cones
14. Kit for cement testing conforming to relevant I.S. Code.

Any other equipment or instruments as shall be instructed to be brought for testing required for the Contractor's scope of work.

The laboratory test is to be carried out by the contractor at his own cost with the all-necessary arrangements in accordance with relevant Indian Standards or equipment of approved standards. The test of materials as follows,

6.48.1. Cement Testing:
Test for fitness, strength, setting time and soundness in accordance with IS:4031.

6.48.2. Concrete Testing:
Test for workability, proportions, density and strength in accordance with IS:516 and 1199. In particular the cube testing machine shall be capable of exerting a slowly applied force up to 200 tonnes and the platens shall be suitable for crushing both 150mm and 200mm cubes. A vibrating table of suitable design shall be provided for compaction of cubes.

6.48.3. Aggregate Testing:
In accordance with IS: 2386 (Part I to VIII) for the following test on both fine and coarse aggregates:

a. Sieve Analysis

b. Determination of bulk density and voids on fine aggregates only:
c. Determination of moisture content, specific gravity and absorption on coarse aggregates only:
d. Determination of specific gravity and absorption.

The contractor shall carry out inspection, testing, checks and also shall maintain records of inspection, testing and checks of material, works and activities related to construction works in the ISO 9001 quality system formats, checklists etc. to be given by the executing agency (the test carrying agency or contractor by himself) during execution period. After getting approval from the engineer/Site in charge/Project manager, the contractor shall print at his own cost of all forms, tables, formats etc. While getting the tests done by a third-party agency/outside laboratory, the contractor shall bear the entire cost including samples, taking samples, testing, reports etc.

6.49. Measurement

The quantity for measurement will be the actual quantity used in construction (which will be calculated on the basis of standard steel co-efficient). Rolling margin, invisible loss, wastage shall not be paid or billed.

2. The contractor shall bear all incidental charges for the storage and safe custody of the materials at site at his own responsibility.
3. The contractor shall make arrangements at the site of works for safe custody of materials to protect from damage by rain, dampness, fire, theft etc.
4. Only that quantity of steel and reinforcing steel, which is shown in the drawings as finished/fabricated steel, will be measured. No wastage, cutting margins, materials used as laps etc. shall be measured for payment. However, approved laps, chairs and spacers in reinforcing steel be measured.
5. Rate of formwork shall be inclusive of desired size and shape. Rates are also inclusive of forming grooves of required size and shape, forming pattas, patterns, rendering etc. Exposed shuttering also includes finishing and rendering of the same and providing holes for conduits/pipes and other inserts.
6. The Rate shall include complete responsibility of curing and all other misc. works.

6.50. Dewatering

Rate quoted for various items in the schedule of quantities, should include cost of dewatering by any means and at all stages which may be from underground or surface water sources. Contractor will not be paid anything extra for dewatering.

6.51. Clearance of site on completion.

On completion of the works, the contractor shall clear away and remove from the site, all constructional plant, surplus materials, rubbish and temporary works of every kind and leave the whole site and work clean and in workmanlike condition to the satisfaction of Owner at his own cost. If the contractor fails to clear the site within 15 days after virtual completion/ submission of final bill whichever is earlier, it shall forfeit all his claims and the owner may get the site cleared at contractor's cost.

6.52. Insurance

The contractor has to take full insurance for Workmen's compensation, third party, Flood, Fire, Earth-quake, riots, any type of accident and contractor's all risks (CAR) Indemnifying the

Client, Architects and Consultants against all losses and damages arising out of any mishap on site, of any claims whatsoever. Insurance policy has to be approved by the Engineer In-charge. Contractor will have to submit all insurance policies before starting work at the site. Necessary warning signs shall have to be put up by the Contractor.

6.53. Payment of RA Bill:

The Contractor shall, on submitting an interim bill every month therefore, be entitled to receive payment proportionate to the part of the work then approved and passed by the Engineer In-charge, whose certificate of such approval and passing of the sum so payable shall be final and conclusive against the Contractor.

1. The Owner shall have power to withhold any certificate if the works or any parts thereof are not being carried out to his satisfaction.
2. Contractor should not stop the work at site due to delay from Engineer In-charge/ Owner regarding certification of monthly bill.
3. The Owner/ Engineer In-charge may, in any certificate, make any correction, in a certificate, previously certified and issued by him.
4. The Owner/ Engineer In-charge shall issue no certificate of payment if the Contractor fails to ensure the works and keep them insured till the issue of the Virtual Completion Certificate.
5. Payments upon the Engineer In-charge's certificate shall be made within 30 days this period named in the Appendix as **"Period for honor of certificates"**.
6. The Owner shall have a right to cause a technical examination of the works and the final bill of the Contractor including all supporting vouchers, abstracts, etc. to be made at the time of payment of the final bill. If as a result of this examination or otherwise any sum is found to have been overpaid or over certified it shall be lawful for the Client to recover the sum.
7. All payment to the contractor shall be subject to TDS under income tax act and other statutory deduction as applicable from time to time.

6.54. Retention Money

Retention at the rate of 5% of the value of work done up to a maximum of 5% of the "Contract value" shall be deducted from each running bill. On the virtual completion of the works and after handing over , the Contractor would be paid 50% of the above-mentioned amount and the remaining 50% shall be released after rectification of the defects, if any, pointed out during the defect's liability period, which will be 12 months from the date of handing over.

The amount retained by the Client shall not bear any interest. All compensation or other sums of money payable by the Contractor to the Client under the terms of this contract may be deducted from his Security Deposit & Retention Money. Unless such deposit has become otherwise payable, the Contractor within ten days shall make good in cash the amount so deducted.

6.55. Item rate tender

The Contractor should note that unless otherwise stated the tender is strictly on item rate basis and his attention is drawn to the fact that the rates for each and every item should be correct, workable and self-supporting. Quantity variation shall be unlimited. The rates shall also be firm and not subject to exchange variations, labor conditions, fluctuations in railway freights or any conditions whatsoever. It shall also include for sales tax, excise duty, octroi

and any other taxes/duty or other levy levied by the Central or State Governments or local authorities, sales tax on works contract if applicable. No claim in respect to the above mentioned shall be entertained by the Client.

6.56. Time limit:

Time shall be the essence of the contract. Time allowed for carrying out the work as mentioned in the memorandum shall be strictly observed by the Contractor and it shall be reckoned from the 7th day after written order to commence the work is issued. The tenderer shall, before commencing work, prepare a detailed work schedule which shall be approved by the Engineer In-charge and the Owner. This schedule shall be strictly followed by the Contractor. In the event of extension, it shall not be treated as a waiver of this clause.

6.57. Authorized permissions

(If Required) The Contractor shall approach, directly to the Municipal and other authorities for obtaining the type of permission required by law.

All fees for the supply of good quality water, including obtaining municipal connection and drainage connection for his labor shall be borne by the Contractor Permanent connection for any of the services if unavailable shall be initially paid by the Contractor and the Client shall reimburse the amount on production of the receipts. Prior intimation and permission from the client/ Engineer In-charge to be considered.

6.58. Electricity

Owner shall give power supply to the contractor, if available, at single point on chargeable basis. The Contractor shall install and maintain at its own cost, an electric meter (Electric board supplier/Electric supply Authority, approved and sealed), cables, switches, ELCB branch connection earthing, protective and safety devices etc., approved by Owner/Electrical Consultant for distribution and measurement of the electrical consumption. The Contractor shall also arrange for necessary permission for all electrical installation, cabling etc.

The Contractor shall be responsible for providing and maintaining the whole of the installation on the load side of supply, as well as all safety aspects covered under I.E. act/I.E. rules, National Electric Code etc. All necessary/safety precautions must be taken and the Contractor's electrical installation shall be subject to the approval by the Owner/Engineer in-charge and must comply with the requirement of the appropriate statutory authorities. Contractor shall not use welding sets for cutting works. Three phase welding machines are preferred. In case of Failure, the contractor will arrange the Alternative arrangement at his own cost.

6.59. Water supply

The Client shall supply water out of the existing connection at single point, if available. The Contractor shall arrange at his own cost the required distribution lines. The Contractor shall not have any claim whatsoever on account of failure of water supply at any time. The Contractor's rates and prices shall be deemed to be inclusive of all such charges and costs.

The Contractor shall arrange for sufficient storage of water to ensure continuity of work. If municipal water is not available and should it be necessary to bore a well or to bring water from outside by tankers, the Client shall not be liable to pay any charges in connection

therewith. In case of Failure, the contractor will arrange the Alternative arrangement at his own cost.

If water supply from statutory authorities is available, then all charges towards temporary connection shall be paid by the contractor and the same shall not be reimbursed. All charges towards permanent connection shall be initially paid by the contractor and the Client shall reimburse the amount on production of the receipts.

6.60. Adhere to the Safety code

The Contractor shall strictly comply with the provisions of safety code annexed hereto as well as all laws pertaining to labor etc.

6.61. Erection of Barricade

The Contractor in his own Cost would erect Metal Barricades around the Entire Periphery of the Site with a Minimum height of 4m. The said height should Visually Cut the View from All surrounding buildings into our said property for safety & security concerns. Also, Barricades at the Entry point with a Gate should be erected to enable ONLY Owners, Architects, Consultants, & authorized staff, workers into the property. Contractor will have to appoint Security Personnel at all Entry/Exit points for check-up during the entire period of construction from the time of Mobilization at No Extra Cost.

6.62. Project-in-charge

The Contractor shall employ full-time technically qualified staff during the execution of the work. Details of probable staff to be appointed at the time of execution shall be submitted at the time of submission of Bid document.

The staff employed for the work must have sufficient experience to handle the work independently. They shall have to stay at the site of work and shall not be entrusted with any other duty except for this work.

The Contractor shall inform the Owners/ Architects/ Consultants/ Engineer In-charge about the name of the qualified Project-in-charge for necessary co-ordinations, discussions, site meetings, and smooth execution of the job.

6.63. Measurements

All works shall be measured net by standard measure and according to the rules and customs of the Mode of Measurement, IS : 1200, without reference to any local custom.

The Contractor shall forthwith attend to or send qualified personnel to assist, in all respects, Engineer In-charge, in taking such measurements and calculations.

6.64. Escalation and mobilizations

1. ***No escalation & mobilization shall be given under any circumstances during contract/ extended period for any reason whatsoever*.**
2. **Extra Items:** Extra items of work will be as far as possible derived from item rates quoted in the Bill of Quantities otherwise it will be calculated on the basis of cost of materials + labour + 15% towards overheads and profit.

6.65. Defect Liability

The works shall not be considered as completed until the Engineer In-charge has certified in writing that they have been virtually completed. The Defects Liability Period shall commence from the date of such Certificate.

Any defect, shrinkage, settlement or other faults which may appear within the "Defects Liability Period" stated in the Appendix here-to or, if non stated, then within Twelve months after the virtual completion of the works, arising in the opinion of the Engineer In-charge from materials or workmanship not in accordance with the contract, shall upon the directions in writing of the Engineer In-charge, and within reasonable time as shall be specified therein, amended and made good by the Contractor, at his own cost and in case of default the Client may employ and pay other persons to amend and made good such defects, shrinkage, settlements or other faults, and all damages, loss and expenses consequent thereon or incidental thereto shall be made good and borne by the Contractor and such damage, loss and expenses shall be recoverable from him by the Client or may be deducted by the Client, upon the Engineer In-charge 's certificate in writing from any money due or that may become due to the Contractor, or the Client may in lieu of such amending and making good by the Contractor, deduct from any moneys due to the Contractor, a sum, to be determined by the Engineer In-charge equivalent to the cost of amending such work and in the event of the amount retained under relevant clause being insufficient, recover the balance from the Contractor, together with any expenses the Client may have incurred in connection therewith. Should any defective work have been done or material supplied by any Sub- Contractor employed on the works who has been nominated or approved by the Engineer In-charge as provided in relevant Clause, the Contractor shall be liable to make good in the same manner as if such work or material had been done or supplied by the Contractor and been subject to the provisions of this Clause and relevant clause. The Contractor shall remain liable under the provisions of this Clause notwithstanding the signing of any certificate or the passing of any accounts, by the Site Engineer .
Owner reserves the right to delete/withdraw any item mentioned in the Bill of Quantities and get it executed /supplied through any other agency as may be deemed fit, at any stage of work.

The waterproofing job has to be executed by an experienced contractor in the said field and as approved by the Engineer In-charge. The guarantee period will be for 10 years. The retention amount for the work will be released over a period of three years on completion of each monsoon.

6.66. Engineer In-charge’s Instructions

The Contractor shall forthwith comply with and duly execute any works comprised in such instructions issued to him by the Engineer In-charge in regard to any matter in respect of which the Engineer In-charge is expressly empowered by these conditions to issue instructions provided always that verbal instructions, directions and explanations given to the Contractor or his work representative by the Engineer In-charge shall if involving a variation be confirmed in writing.

If within seven days after receipt of a written notice from the Engineer In-charge, requiring compliance with an instruction the Contractor does not comply herewith, then the Owner

may employ and pay other persons to execute any work whatsoever which may be necessary to give effect such instructions and all cost incurred with such employment shall be recoverable from the Contractor by the Owner as a debt or may be deducted by him from any monies due or to become due to the Contractor under this contract.

Upon receipt of what purports to be instruction issued to him by the Engineer In-charge the Contractor may request the Engineer In-charge to specify in writing the provision of these conditions which empowers the issue of the said instruction? The owner shall forthwith comply with any such request, and if the Contractor shall thereafter comply with the said instruction, then the issue of the same shall be deemed for all purposes of this Contract to have been empowered by the provision of these Conditions specified by the Engineer In-charge in answer to the Contractor's request.

All instructions issued by the Engineer In-charge shall be in writings. Any Instruction issued orally shall be of immediate effect but, shall be confirmed in writing by the Contractor to the Engineer In-charge within seven days, and if not dissented from in writing by the Engineer In-charge to the Contractor within seven days from receipt of the Contractor's confirmation shall take effect as from the expiration of the latter said seven days.

Provided always that if the Engineer In-charge within seven days of giving such an oral instruction shall himself confirm the same in writing, then the contractor shall not be obliged to confirm as aforesaid, and the said instruction shall take effect as from the date of the Engineer In-charge's confirmation and

That if neither the Contractor nor the Engineer In-charge shall confirm such an oral instruction in the manner and at the time aforesaid but the Contractor shall nevertheless comply with the same, then the Engineer In-charge may confirm the same in writing at any time prior to the issue of the Final Certificate, and the said instruction shall thereupon be deemed to have taken effect on the date on which it was issued.

6.67. Facilities and Co-operation

In the case of works indicated on the Drawings but not included in the Contract the contractor shall provide necessary facilities and co-operation for any Subcontractor or supplier who may be approved by the owner. The contractor shall do all cutting, filling or patching of his work that may be required to make its several parts come together properly and fit it to receive or be received by work of other Contractors shown upon on reasonably implied by the Drawings and Specifications for the completed structure, and he shall make good after them as the Engineer In-charge may direct. Any cost caused by the defective or ill-timed work shall be borne by the party responsible therefore.

The Contractor shall not endanger any work by cutting, excavating or otherwise altering the work and shall not cut or alter the work of any other contractor save with the consent of the Engineer In-charge.

6.68. Setting Out

The Engineer In-charge shall determine any lines levels which may be required for the execution of the work and shall furnish to the Contractor by way of accurately dimensioned drawings such information as shall enable the Contractor to set out the Work at ground level.

The Contractor shall set out and level the work and shall be responsible for the accuracy of the same. He shall provide all the instruments and attendance required by the Engineer In-charge for checking the work. He shall entirely at his own cost amend to the satisfaction of the Engineer In-charge any error found at any stage which may arise through inaccurate setting.

The Contractor shall not be paid for any assistance and material such as pegs, side rails, nails, line dory measuring tapes etc., given by him to the Site Engineer required for lining out or leveling etc. The marks and points once given by the Site Engineer shall be carefully maintained.

6.69. Samples and Shop Drawings

After the award of the Contract, the Contractor shall furnish for the approval of the Engineer In-charge, with such promptness as to cause no delay in his work or in that of any other Sub-contractor, program, samples and shop drawing required by the specifications or by the Engineer In-charge. Samples shall be delivered as directed by the Engineer In-charge.
Schedule giving dates for the submission of samples shall be included in the schedule. Unless specifically authorized all samples must be submitted for approval within sixty days of signing the Contract and not less than one hundred for twenty days before the date and particular work is scheduled to begin.

The Engineer In-charge shall check and approve such samples, with reasonable promptness only for conformity with the design concept of the project and for compliance with the information in the Contract Documents. The work shall be in accordance with the approved samples.

6.70. Progress Chart

The Contractor shall prepare progress charts and submit the same for approval of the Engineer In-charge and for his record within twenty-one days of the Award of the Contract. The charts shall indicate the expected date of commencement and completion of each of the items of the work and shall be in a form approved by the Engineer In-charge. The Chart shall also include the scheduling of samples, Shop Drawings and approvals.

6.71. Access for Engineer In-charge to the Works

The Engineer In-charge and his representatives shall at all reasonable times have access to the works and to the workshops or other places of the Contractor where work is being prepared for the Contract and when work is to be so prepared in workshops or other place of a Sub-Contractor (whether or not a nominated sub-contractor) the contractor shall have a term in the Sub-Contract so as to secure a similar right to access to those workshops or places for the Engineer In-charge and his representatives and shall do all things reasonably necessary to make such right effective.

6.72. Engineer In-charge Statutes and Decisions

The Engineer In-charge shall be the Owner's representative during the Construction Period. The Architect shall periodically visit the site to familiarize himself generally with the progress and the quality of the work and to determine in general if the work is proceeding in accordance with the Contract Document. He shall not be required to make exhaustive or continuous on-site inspections to check the quality or quantity of the work and he shall not be responsible for the Contractor's failure to carry out the construction work in accordance with the Contract Document. During such visits and on the basis of his observation while at the site he shall keep the Owner informed of the progress of the work, shall endeavor to guard the Owner only to the extent expressly proved in the Contract Document or otherwise in writing which shall be shown to the contractor. He shall have authority to stop the work whenever such stoppage may be necessary in his reasonable opinion to ensure the proper execution of the contract.

The Engineer In-charge shall be in the first instance the interpreter of the conditions of this Contract and the judge of its performance. He shall side neither with the Owner nor with the Contractor but shall use his powers under the Contract to enforce its faithful performance.

Decision: The Engineer In-charge shall within a reasonable time make decisions on all claims of the Owner or the Contractor and all other matters relating to the execution and progress of the work or the interpretation of the Contract Document.

The Engineer In-charge may in his absolute discretion and from time-to-time issue further drawings. Details and/or written instruction, written directions and written explanations in regard to

1. Variation or modifications of the design.
2. The quality or the quantity of works or the additions or omission or Substitution of any work.
3. Any discrepancy in or divergence between the drawings and/or Specifications.
4. The removal and / or re-execution of any works executed by the Contractor.
5. The dismissal from the works of any persons employed thereon.
6. The opening up for inspection of any work covered up.
7. The amending and making good of any defects under Defects Liability Period.
8. The removal from the site of any materials brought thereon by the Contractor and Substitution of any other material thereof.
9. Assignment and subletting.
10. Delay and extension time.
11. The postponement of any work to be executed under the provision of this contract.

6.73. Dismissal

The contractor shall on the request of the Owner immediately dismiss from the works any person employed thereon by him who may in the opinion of the Engineer In-charge be incompetent or misconduct's himself and such person shall not be again employed on the work without the permission of the Engineer In-charge.

6.74. Contractors field organization and Equipment

Site Engineer: The Contractor shall constantly keep on his work during its progress one or more qualified and competent Site Engineers, who will be responsible for the carrying out of the works to the true meaning of the Drawings. Specifications and Schedule of Quantities, Engineer In-charge's instructions and directions to the satisfaction of the Engineer In-charge. Any directions or instructions given by him by the Engineer In-charge t shall be deemed to have been issued to the Contractor. Attention is called to the importance of requesting instruction from the Owner before undertaking any work where the Engineer In-charge's directions or instruction are required. Any such work done in - advance of such instruction will be liable to be removed.

Equipment: The Contractor shall provide and install all necessary hoists, ladders, scaffolding, tools, tackles, plants, all transport for labour materials and plant necessary for the proper carrying on execution and completion of the work to the satisfaction of the Engineer In-charge t.

Office Accommodation: The Contractor shall provide erect and maintain where directed, simple watertight office accommodation for the foreman and the Project Manager. This accommodation shall be well lighted and ventilated and provided with windows, doors with a lock and a Telephone. The Project Manager's office shall have a minimum of 100 Sqft. and shall have a desk, chair and drawers for keeping drawings and tack board for displaying drawings. The accommodation to be demolished when directed.

Watchman: The Contractor shall make his own security arrangements to guard the Site and premises at all times, at his own expense. The security arrangements shall be adequate to maintain strict control on the movement of material and labour. The Contractor shall extend the security arrangements to guard the material stored and / or fixed on the premises by the Sub-Contractors.

Storage of Materials: The Contractor shall provide, erect and maintain proper sheds for the storage and protection of the materials etc. And also, for the execution of work which may be prepared on the site.

Sanitary Conveniences: The Contractor shall provide and erect all necessary sanitary convenience for the Site-staff and the workmen, maintain it in a clean orderly condition and clean and deodorize the ground after removal.

Scaffolding, Staging, Guard-rails: The Contractor shall provide scaffolding, staging, guard-rails, temporary stairs which shall be required during construction. The support for the scaffolding, staging, guard-rails and temporary stairs shall be strong, adequate for the particular situation. The temporary access to the various parts of the building under construction shall be rigid and strong enough to avoid any chance of mishaps. The arrangements proposed shall be subject to the approval of the Engineer In-charge, The Contractor shall allow the same to be used by plumbers and all other contractors during the progress of the work.

6.75. Taxes

The Contractor shall add to the amount of his tender the amount of sales tax duty, any other tax for octroi legally payable and it shall be assumed his rates cover for all taxes and duties and no claim on this account will be entertained.

Statutory obligations, notices, fees and charges:

The Contractor shall comply with and give all notices required by any Government authority and instrument, rule or order made under any Act or Parliament or any regulation or Bye-law of any local authority relating to the work or with whose system the same is or will be connected. The Contractor before making any variation from the Contract Drawings or Contract Bills necessitated by such compliance shall give to the Engineer In-charge a written notice specifying and giving reasons for such variations and the Engineer In-charge may issue instruction in regard thereto. If within 10 days of having given the said written notice the Contractor does not receive any instructions in regard to the matters therein specified, he shall proceed with the work conforming to the Act of Parliament, instrument, rule, order, regulations or Bye-law in question and any variation thereby necessitated shall be deemed to be variation required by the Engineer In-charge.

The Contractor shall pay and indemnify the Owner against liability in respect of any fees or charges (including any rates and taxes) legally demandable under any Act of Parliament, instrument, rule or order or any regulation or Bye-law or any local authority in respect of the work.

6.76. Licenses and Permits for Materials under Government Control

Licenses and Permits for all materials under Government control shall be obtained by the Contractor through the collaboration and help of the Owner/Architect, the Contractor shall include in his tender all transport charges and other expenses likely to be incurred to bring the materials to the site.

6.77. Assignment and Subletting

The Contractor shall not without the written consent of the Engineer In-charge assign this Contract, and shall not without the written consent of the Engineer In-charge (which consent shall not be unreasonably withheld to the prejudice of the Contractor) Sub-let any portion of the work.

Sub-Contractor

As soon as practicable and before awarding any Sub-Contract, the Contractor shall notify the Engineer In-charge t in writing the names of the Sub-Contractor proposed for the principal parts of the work and for such other parts of the Engineer In-charge may direct, and shall not employ any of whom the Owner or the Engineer In-charge may have a reasonable objection.

The Engineer In-charge, however, shall have power to obtain estimates and select other agencies to carry out any of the work as described below.

All specialists, Merchants, tradesmen, and others executing any works or supplying and fixing any goods, who may be nominated or selected by the Engineer In-charge shall be deemed to be Sub-Contractors employed by the Contractors and are to be referred as nominated Sub-Contractors. No nominated Sub-Contractor shall be employed on or in connection with the

work against whom the Contractor shall make reasonable objection or (save where the Engineer In-charge and Contractor shall otherwise agree) who will not enter into a contract providing.

a. That the nominated Sub-Contractor shall carry out and complete the sub-contract works in every respect to the reasonable satisfaction of the Contractor and of the Engineer In-charge and in conformity with all the reasonable direction and requirements of the Contractor.
b. That the nominated Sub-Contractor shall observe, perform and comply with all the provision of this Contract on the part of the contract to be observed, performed and complied with the conditions mentioned. so far as they relate and apply to the Sub-contract works or to any portion of the same,
c. That the nominated Sub – Contractor shall indemnify the Contractor against the same liabilities in respect of the Sub-Contract work as those for which the Contractor is liable to indemnify the owner under this Contract.
d. That the nominated Sub-contractor shall indemnify the Contractor against claims in respect of any negligence, omission or default of such sub – contractor, his servants or agents or any misuse by him or them of any scaffolding or other plant, and shall insure himself against any such claims and produce the policy, or policies and premium and premium receipts as when required by the Contractor or Engineer In-charge.
e. That payment in respect of any work, materials or goods comprised in the Sub-contract shall be made within thirty days after receipts by the Contractor of the Engineer In-charge's certificate under as mentioned in Instructions & Payments terms & conditions of these conditions which states as due an amount calculated by including the total value of such work, materials or goods, and shall when due to subject to the retention by the Contractor of the sums mentioned in sub-paragraph (J)
f. That the Owner/Architect/ Engineer In-charge and his representative shall have right to access to the workshops and other places of the nominated Sub-contractor with no conditions apply.
g. That the Sub-Contractor's work shall be completed within the period or (where they are to be completed in sections) periods therein specified, that the Contractor shall not without the written consent of the Engineer In-charge grant any extension of time for the completion of the Sub-Contract work or any section thereof, and that the Contractor shall inform the Engineer In-charge of any representation made by the nominated Sub-Contractor as to the cause of any delay in the progress of completion of the Sub-Contract work or of any section thereof.
h. That if the nominated Sub-Contractor shall fail to complete the Sub-Contract work or (where the Sub-Contract works are to be completed in sections) any section thereof within the period therein specified or within any extended time granted by the Contractor with the written consent of the Engineer In-charge, and the Engineer In-charge certifies in writing to the Contractor that the same ought reasonably so to have been completed the nominated Sub-contractor shall pay or allow to the Contractor either a sum calculated at the rate therein agreed as Liquidated and Ascertained Damages for the period during which the said work or any section thereof, as the case may be, shall so remain or have remained incomplete or (where no such rate is therein agreed), a sum equivalent to any loss or damage suffered or incurred by the Owner

and caused by the Contractor and/or caused by the failure of the nominated Sub-Contractor as aforesaid.

i. That the Contractor shall retain from the sum as directed by the Engineer In-charge having been included in the calculation of the amount stated as due in any certificate issued for completion of billing of these conditions in respect of the total value of work, materials or goods executed or supplied by the nominated Sub-Contractor the percentage of such value named in the appendix of these conditions as percentage of certified value retained up to a total amount not exceeding a sum which bears the same ratio to the Sub-Contract price as the unreduced sum named in the appendix to these conditions as limited of Retention Fund bears to the Contract sum; and that the Contractor's interest in any sums so retained (by whomsoever held) shall be fiduciary as trustee for the nominated Sub-Contractor (but without obligation to invest); and that the nominated Sub-Contractor's beneficial interest in such sums shall be subject only to the right of the Contractor to have recourse thereto from time to time for payment of any amount which he is entitled under the Sub-contract to deduct from any sum due or to become due to the nominated Sub-Contractor; and that if and when such sums or any part thereof are released to the nominated Sub-Contractor they shall be paid in full if paid within 14 days of the date fixed for their release in the Sub-Contract.

Before issuing any certificate the Engineer In-charge may request the Contractor to furnish to him reasonable proof that all amounts included in the calculation of the amount stated as due on previous certificates in respect of the total value of work materials or goods executed or supplied by any nominated Sub-Contractor have been duly discharged and if the Contractor fails to comply with any such request the Engineer In-charge shall issue a certificate to that effect and thereupon the Owner may himself pay such amounts to any nominated Sub-Contractor concerned and deduct the same from any sums due or to become due to the Contractor.

The Contractor shall not grant to any nominated Sub-Contractor any extension of the period within which the Sub-Contract work or (where the Sub-Contract works are to be completed in sections) any section thereof is to be completed without the written consent of the Engineer In-charge. Provided always that the Contractor shall inform the Engineer In-charge of any representation made by the nominated Sub- Contractor as to the cause of any delay in the progress or completion of the Sub-Contract work or any section thereof and that the consent of the Engineer In-charge t shall not be reasonably with-held.

If any nominated Sub-Contractor fails to complete the Sub-Contract work (Where the Sub-contract works are to be completed in sections) any section thereof within the period specified in the Sub-Contract or within the extended time granted by the Contractor with the written consent of the Engineer In-charge then if the same ought reasonably so to have been completed the Engineer In-charge shall certify in writing accordingly. Any such certificates shall be issued to the Contractor and immediately upon issue the Engineer In-charge shall send a duplicate copy to the nominated Sub-Contractor.

If the owner desires to secure final payment to any nominated Sub-Contractor before final payment is due to the Contractor, and if such Subcontractor has satisfactorily indemnified the Contractor against any latent defects, then the Engineer In-charge may in an Interim

Certificate include an amount to cover the said final payment and thereupon the Contractor shall pay such nominated Sub-Contractor the amount so certified. Upon such final payment, the amount named in the appendix to these conditions as limit of retention fund shall be reduced by the sum which bears the same ratio to the said amount as does such Sub-Contractor's Sub-Contract price to the Contract Sum, and save for latent defects the Contractor shall be discharged from all liability for the work materials or goods executed or supplied by such Sub-Contractor under the Sub-Contract to which the payment relates.

Neither the existence nor the exercise of the foregoing powers nor anything else contained in these conditions shall render the owner/EIC/Architect in any way liable to any nominated Sub-Contractor.

Where the Contractor in the ordinary course of his business directly carries out works for which Prime Cost or Provisional Sums are included in the Contract Bills and the Engineer In-charge is prepared to receive tenders from the Contractors for such items, then the Contractor shall be permitted to tender for the same or any of them but without prejudice to the Owner right to reject the lowest or any tender. If the Contractor's tender is accepted, he shall not sublet the work without the consent in writing of Engineer In-charge.

It shall be a condition of any tender accepted under this paragraph that these conditions shall apply in respect of the Work included in the tender as if for the reference therein to the Contract Drawings and the Contract Bills there were references to the equivalent documents included in or referred to in the Tender.

The Contractor shall allow for general attendance upon Sub- Contractors including free use of plant scaffolding and is to allow them the use of sanitary conveniences, storage facilities other amenities and affording them all reasonable facilities for carrying out their Contracts.

6.78. Claim for Extra

When any instruction or decision given at site involve an extra or
Whereby the Contractor may plan to claim an extra, it shall be the responsibility of the Contractor to inform the Engineer In-charge of the extra amount and get written authorization from the Engineer In-charge before proceeding with the work involved.

Any modification carried out for expediting or simplifying work at the request of the Contractor or his representatives shall not be taken as the basis for claiming an extra. However, if such modification shall also involve an extra, the rate for such modification shall be settled in advance and written authorization obtained by the Contractor from the Engineer In-charge before proceeding with the work involved. If no such information is given by the Contractor in writing to the Engineer In-charge such modification shall not be accepted as the basis for extra charge.

6.79. Deduction from uncorrected work

If the Engineer In-charge deems it inexpedient to correct work damaged or not done in accordance with the contract, an equitable deduction from the Contract price shall be made therefore.

6.80. Fluctuations

The Contractor shall not claim any extras for fluctuation of price and the Contract price shall not be subject to any rise or fall of prices.

6.81. Unfixed goods and materials

Unfixed materials and goods intended for, delivered to and placed on or adjacent to the work shall not be removed except for use upon the work unless the Engineer In-charge has consented in writing to such removal which consent shall not be unreasonably withheld. Where the value of any such materials or goods has in accordance with conditions been included in any Interim Certificate under the Contract for which the Contractor has received payment, such materials and goods shall become the property of the Owner, but subject to conditions in accordance with architects/client (if applicable) the Contractor shall remain responsible for loss or damage to the same.

6.82. Materials and Workmanship

All materials and workmanship shall be as per the relevant code of I.S.I specification and of approved type and the Contractor shall immediately remove from the works any material and /or workmanship which in the opinion of the Engineer In-charge are defective or unsuitable and shall substitute proper materials and/or workmanship at his own cost. The term approval used in connection with this contract shall mean the approval of the Owner and / Engineer In-charge / or Architect.

The Contractor shall if required submit satisfactory evidence as to the kind and quality of material.

Where special makes or brands are called for, they are mentioned as a Standard. Others of equal quality may be used provided approval is first obtained in writing from the Engineer In-charge. Unless substitution is requested no deviation from the Specification will be permitted. Failure to propose the substitution of any article within 30 days after signing of the contract will be deemed sufficient cause for denial of the request for substitution.

The Contractor shall indicate and submit evidence in writing of those materials or articles called for in the specification that are not obtainable for installation in the work within the Time Limits of the Contract. Failure to indicate the above, within 30 days after the signing of the Contract, will be deemed sufficient cause for the denial of request for the extension of the Contract time.

All material shall be delivered so as to insure a speedy and Uninterrupted progress of the work. Such material shall be stored so as to cause no obstruction and so as to prevent overloading of any portion of the structure, and the Contractor shall be entirely responsible for damage or loss by weather or other cause.

Within 30 days after signing the Contract, the Contractor shall submit for approval of the Owner a complete list of all material he and his Sub-Contractors propose to use in the work of definite brand or make which differs in any respect from those specified; and the particular brand of any article where more than one is specified as a standard. He shall also list items

not specifically mentioned in the specifications but which are reasonably inferred and necessary for the completion of the work.

The correctness and trueness of work such as quality, plumb etc., shall solely be the Contractor's responsibility throughout the contract period and the contractor shall have to rectify the same at his own cost at any stage during the contract.

Any defect in workmanship or correctness of job, if not pointed out by the Site staff does not absolve the Contractor of the responsibility to get the same rectified at his own cost immediately and or till the validity of contract.

6.83. Inspection

All materials and workmanship shall be subject to inspection, examination and test by the owner at any and all items during manufacture and /or construction. The Engineer In-charge shall have the right to reject defective material and workmanship or require its correction. Rejected workmanship shall be satisfactorily replaced with proper material without additional charge therefore and the Contractor shall promptly segregate and remove the rejected material from the Works. If the Contractor fails to proceed at once with the replacement of rejected materials and or the correction of defective workmanship, the Engineer In-charge may by contract or otherwise replace such materials and/or terminate the right of the Contractor to proceed further with the work.

The Contractor shall furnish promptly without additional charge all reasonable facilities, labor and materials necessary for the safe and convenient inspection and test that may be required by the Engineer In-charge.

6.84. Defects

The Contractor shall make good at his own cost and to the satisfaction of the Engineer In-charge, all defects, shrinkage or small faults, arising in the opinion of the Owner/ Engineer In-charge from work or materials not being in accordance with the Drawings or Specifications or Schedule of Quantities or the instructions of the Engineer In-charge t, which may appear within "Defects Liability Period" referred to in the appendix.

Such defects, shrinkage shall upon directions in writings of the Engineer In-charge, and within such reasonable times as shall be specified therein be amended and made good by the Contractor, at his own cost unless the Engineer In-charge shall decide that he ought to be paid for such amending and making good in case of default the Owner may employ and pay other Contractor to amend and make good such defects, shrinkage, settlements or other faults and all damages loss and expense consequent thereon or incidental expense shall be recoverable from him by the owner or may be deducted by the Owner upon the Engineer In-charge's certificate in writing from any amount due or may become due to the Contractor or the Owner may, in lieu of such amending and making good by the Contractor deduct from any moneys due to the Contractor a sum to be determined by the Engineer In-charge as equivalent to the cost of amending such work and in the event of the Retention Amount being insufficient to recover the balance from the Contractor, together with any expenses the Owner may have incurred in connection therewith.

6.85. Possession completion and postponement

On the date for commencement stated in the appendix to these conditions, license may be granted to the Contractor, to enter upon site with his workmen, laborers, materials, equipment's etc., who shall thereupon begin the works and regularly and diligently proceed with the same, and who shall complete the same on or before the date of Completion stated in the said appendix. The possession of the site shall always remain with the owners.

The Owner may issue instructions in regard to the postponement of any work to be executed under the provisions of this contract.

If any time or times before Virtual Completion of the work the owner with the consent of the Contractor shall take away from the Contractor any part or parts of the work assigned to him for handing over to the Finishing Contractor or other agency, then notwithstanding anything expressed or implied elsewhere in this Contract:

Such parts shall not be deemed to be Virtually Complete.

Virtual Completion of such parts or parts would occur on the completion of the last part of the structure under this Contract.

The Contractor shall not claim that such part or parts are complete and request refund of payments in lieu thereof.

6.86. Damages for non - completion

If the Contractor fails to complete the works by the date specified in these conditions or within any extended time fixed under these conditions and the Engineer In-charge certifies in writing that in his opinion the same ought reasonably so to have been completed, the Contractor shall pay or allow to the owner a sum calculated at the rate stated in the appendix as agreed Liquidated Damages for the period during which the said work shall so remain or have remained incomplete, the Owner may deduct such damages from any monies otherwise payable to the Contractor under this Contract.

6.87. Virtual Completion and Defects Liability Period

When in the opinion of the Owner the Works are practically completed, he shall forthwith issue a certificate to that effect and Virtual Completion of the Works shall be deemed for all purpose of this Contract to have taken place on the day named in such certificate.

Any defects shrinkage or other faults which shall appear within the "Defects Liability Period" stated in the appendix to these conditions and which are due to materials and workmanship not in accordance with this Contract shall be specified by the Owner in a Schedule of Defects which he shall deliver to the Contractor not later than 14 days after the expiration of the said Defects Liability Period and within a reasonable time after receipt of such Schedule the Detects Shrinkage and other faults therein specified shall be made good by the Contractor and (unless the Engineer In-charge shall otherwise instruct in which case the Contract Sum shall be adjusted accordingly) entirely at his own cost.

The Engineer In-charge may whenever he considers it necessary so to do, issue instruction requiring any defect, shrinkage or other fault which shall appear within the Defects Liability Period named in the appendix to these conditions and which is due to materials and workmanship not in accordance with this Contract to be made good and the Contractor shall within a reasonable time after receipt of such instructions comply with the same (and unless the Owner shall otherwise instruct in which case the Contract sum shall be adjusted accordingly) entirely at his own cost. Provided that no such instruction shall be issued after 14 days from the expiration of the said Defects Liability Period.

When in the opinion of the Engineer In-charge any defects, shrinkage or other defaults which he may have required to be made good wherein he shall issue a certificate to that effect, and completion of making good defects shall be deemed for all purposes of this Contract to have taken place on the day named in such certificates.

In no case shall the Contractor be required to make good at his own cost any damage which may appear after Virtual Completion of Work, unless the Engineer In-charge shall certify that such damage is due to injury which took place before Virtual Completion of the Works.

6.88. Loss and expense caused by disturbance of regular progress of the works

If upon written application being made to him by the Contractor, the Engineer In-charge is of the opinion that the Contractor has been involved in direct loss and / or expense for which he would not be reimbursed by a payment made under any other provision in this Contract by reason of the regular progress of the works or any part thereof having been materially affected by:

The Contractor not having received in due time necessary instructions, drawing details or levels from the Engineer In-charge for which he specifically applied in writing on a date which having regard to the date of completion stated in the appendix to these conditions was neither unreasonably distant from nor unreasonably close to the date on which it was necessary for him to receive the same, or

The opening up for inspection of any work covered up or the testing of any work material or goods in accordance with conditions stated in this document (including making good in consequence of such opening up or testing), unless the inspection or test showed that the work materials or goods were not in accordance with this Contract; or

Any discrepancy or divergence between the Contract Drawings and/or the Contract Bills; or Delay on the part of the Artists Tradesmen or others engaged by the owner in executing work not forming part of this Contract; Or

Engineer In-charge's instructions issued in regard to the postponement of any work to be executed under the provisions of this Contract; and if the written application is made within a reasonable time of it becoming apparent that the progress of the work or of any part thereof has been affected as aforesaid.

Then the Engineer In-charge shall ascertain the amount of such loss and/or expense. Any amount time to time so ascertained shall be added to the amount which would otherwise be stated as due in such certificate.

The provisions of this condition are without prejudice to any rights and remedies which the contractor may possess

6.89. Payments withheld

The Engineer In-charge may withhold or on account of subsequently discovered evidence nullify the whole or a part of any certificate to such extent as may be necessary to protect the Owner from loss on account of: Defective work not remedied.

Failure of the Contractor to make payments properly to Sub-Contractor or for materials or labor. A reasonable doubt that the Contract can be completed for the balance then unpaid. Damage to another Contractor or Sub-Contractor. Claims field on reasonable evidence indicating probable filing of claims.
When the above grounds are removed payment shall be made for amounts withheld because of them.

6.90. Injury to Persons and property Owner

The Contractor shall be liable for and shall indemnify the Owner against any liability, loss, claim or proceedings whatsoever arising under any statue or at common law in respect of personal injury to or the death of any person whomsoever arising out of or in the course of or caused by the carrying out of the works, unless due to any act or neglect of the Owner or any person for whom the Owner is responsible.

Except for such loss or damages as is at the risk of the Owner these Conditions (if applicable) the Contractor shall be liable for and indemnify the Owner against any expense, liability, loss, claim, or proceedings in respect of any injury or damage whatsoever to any property real or personal in so far as such injury or damage arises out of or in the course of or by reason of the carrying out of the works. And provided always that the same is due to any negligence, omission or default of the contractor, his servants or agents or of any Sub-Contractor, his servants or agent.

6.91. Insurance against injury to Persons and Property

Without prejudice to his liability to indemnify the Owner under clause 5.46. of these conditions, the Contractor shall maintain and shall cause any Subcontractor to maintain;

Such insurance's as are necessary to cover the liability of the Contractor or as the case may be of such Sub-Contractor, in respect of personal injuries or deaths arising out of or in the course of or caused by the carrying out of the work; and

Such insurance's as may be specifically required by the Contract Bills in respect of injury or damage to property real or personal arising out of or in the course of or by reason of the carrying out of the work, and caused by any negligence, omission or default of the Contractor, his servants or agents or, as the case may be of such Sub-Contractor, his servants or agents.

The Contractor shall produce or cause any Subcontractor to produce for inspection the relevant policy or policies of insurance together with the receipts in respect of premiums paid under such policy or policies as and when requires so to do by the Engineer In-charge provided always that as and when may be reasonably required by the Engineer In-charge the production by either the Contractor or any Sub-Contractor of a current certificate of insurance from the company or firm which shall have issued the policy or policies aforesaid shall be a good discharge of the Contractor's obligation to produce or to cause the production of the policy or policies and the receipts in respect of premium paid.

The Contractor shall maintain in the joint names of the Owner and Contractor such insurance's as may be required in respect of any expense, liability. Loss, claim or proceedings which the Owner may incur or sustain by reason of injury or damage to property real and personal arising out of or in the course of or by reason of the carrying out of the work, and caused otherwise than by the negligence, omission or default of the Contractor, his servants or agents of any Sub-Contractor, his servants or agents.

Any such insurance as is referred to in the immediately preceding paragraph shall be placed with insurers to be approved by the Owner and the Contractor shall have to deposit with him the policy or policies and the receipts in respect of premiums paid.

Should the contractor or any Subcontractor make default in insuring or in continuing to insure as provided in sub-clauses of this condition the Owner may himself insure against any risk with respect to which the defaults shall have occurred and may deduct a sum equivalent to the amount paid in respect of premiums from any monies due to or become due to the Contractor.

6.92. Insurance of the works against Fire Etc.

The Contractor shall in the joint names of the Owner and Contractor insure against loss or damage by fire, storm, tempest, lightning, flood, earthquake, aircraft or anything dropped there from, aerial objects, riot and civil commotion for the full value thereof all work executed and all unfixed materials and goods intended for, delivered to and placed on or adjacent to the worm, but excluding temporary building plant, tools and equipment owned or hired by the Contractor or any Sub-Contractor and shall keep such work materials and goods so insured until Virtual Completion of the work. such insurance's shall be with insurers approved by the Engineer In-charge and the Contractors shall deposit with the Engineer In-charge the policy or policies and the receipts in respect of premiums paid; and should the Contractor make default in insuring or continuing to insure as aforesaid the Owner may himself insure against any risk with respect of which the default shall have occurred and deduct a sum equivalent to the amount paid by him in respect of premium from any monies due to or to become due to the Contractor.

Provided always that if the Contractor shall independently of his obligations under this contract maintain a policy of insurance which covers (inter alia) the said work, materials and goods against the aforesaid contingencies to the full value thereof then the maintenance by the contractor of such policy shall if the Owners interest is endorsed thereon, be a discharge of the Contractor's obligation to insure in the joint names of the Owner and Contractor and the production by the Contractor as and when may reasonably be required by the Owner of

a current certificate of insurance from the company or firm which shall have issued the said policy shall be a discharge of the Contractor's obligation to deposit with the Engineer In-charge a policy or policies and the receipts of premium paid.

6.93. Determination by the Owner

Default: If the Contractor shall make default in any one or more of the following respects, that is to say:

- If he without reasonable cause wholly suspends the carrying out of the works before completion thereof, or
- If he fails to proceed regularly and diligently with the works or
- If he refuses or persistently neglects to comply with a written notice from the Owner requiring him to remove defective work or improper materials or goods and by such refusal or neglect the work is materially affected, or if he fails to comply with the provision mentioned in the tender document.

Then the Engineer In-charge may give him the notice by registered post or recorded delivery specifying the default, and if the Contractor either shall continue such a default for 14 days after receipt of such a notice and shall at any time thereafter repeat such a default (whether previously repeated or not). Then the owner without prejudice to any other rights or remedies may within 10 days after such continuance or repetition of notice by registered post or recorded delivery forth with determine the employment of the Contractor under this Contract, provided that such notice shall not be given unreasonably or vexatious.

Bankruptcy of Contractor: In the event of the Contractor becoming bankrupt or making a composition or arrangement with his creditors or being a company having a winding up order made or (except for purposes of reconstruction) a resolution for voluntary winding up passed or a receiver or manager of his business or undertaking duly appointed or possession taken. By or on behalf of the holders of any debentures secured by a floating charge, of any property comprised in or subject to the floating charge, the employment of the Contractor under this Contract shall be forthwith automatically determined but the said employment may be reinstated and continued if the Owner and the Contractor, his trustee in bankruptcy, liquidator, receiver or manager as the case may shall be so agreed.

The owner shall be entitled to determine the employment of the Contractor under this Contract. If the Contractor shall have offered or given or agreed to give to any person any gift or consideration of any kind as in inducement or reward for doing or forbearing to do or for having done or forborne to do any action in relation to the obtaining or execution of this Contract with the Owner, or for showing or forbearing to show favor or disfavor to any person in relation to this Contract or any other Contract with the owner the contractor or any person employed by him or acting on his behalf shall have committed any offense under the prevention of corruption act, or shall have any fee or reward the receipt of which is an offense under the Local Government Act.

In the event of the employment of the Contractor being determined as aforesaid and so long as it has been reinstated and continued, the following shall be the respective rights and duties of the Owner and Contractor.

The owner may employ and pay other persons to carry out and complete the works and he or they may enter the Works and use all the temporary buildings, plant, machinery, appliances, goods and materials intended for, delivered to and placed on or adjacent to the works and may purchase all materials and goods necessary for the carrying out and completion of the works.

The Contractor shall if so required by the Owner/Architect within 14 days of the date of determination, assign to the Owner without payment the benefit of any Agreement for the supply of materials or goods and/or for the execution of any works for the purposes of this Contract but on the terms that a supplier or Subcontractor shall be entitled to make any reasonable objection to any further assignment thereof by the Owner. In any case the Owner may pay any supplier or Sub- Contractor for any materials or goods delivered or Works executed for the purpose of the Contract (Whether before or after the date of determination), in so far as the price thereof has not already been paid by the Contractor. The Owner's right under this paragraph is in addition to his rights to pay nominated Sub-Contractors and payments made under this paragraph may be deducted from any sum due or to become due to the Contractor.

The Contractor shall as and when required in writing by the Owner so to do (but not before) remove from the Works any temporary buildings, plant, tool, equipment's, goods and materials belonging to or hired by him. If within a reasonable time after any such requirements has been made the Contractor has not complied therewith then the owner may (but without being responsible for any loss or damage) remove and sell any such property of the Contractor, holding the proceeds less all costs incurred to the credit of the Contractor.

The Contractor shall allow to pay to the owner in the manner hereinafter appearing the amount of any direct loss and/or damage caused to the Owner by the determination. Until after completion of the works under this Sub-clause the owner shall not be bound by any provisions of this Contract to make any further payment to the contractor, but upon such completion and the verification within a reasonable time of the accounts therefore the Architect shall certify the amount of expense properly incurred by the Owner and the amount of any direct loss and/or damage caused to the Owner by the determination and if such amounts when added to the monies paid to the Contractor before the date of determination exceed the total amount which would have been payable on due completion in accordance with this Contract, the difference shall be a debt payable to the Owner by the Contractor, and if the said amounts, when added to the said monies be less than the said total amounts, the difference shall be a debt payable by the Owner to the contractor.

6.94. Labor

The Contractor shall employ no child labor under 18 years of age on the work. If female labor is engaged the Contractor shall make necessary provision for safeguarding small children and keeping them clear of the site of operations.

It is mandatory that the labour should not stay on the site, without the prior approval of A Engineer In-charge /owner. Post works the site has to be locked under the security supervision and labour to be moved out to their stay.

The contractor shall provide and dismantle hutments for his labour at site at his own cost at a suitable location given by the Site Engineer.

6.95. Protections of trees and Shrubs

Trees and Shrubs designated by the Engineer In-charge shall be protected from damage during the course of the work and earth level shall not be changed within three feet of such tree. Where necessary such trees and Shrubs shall be protected by means of temporary fencing.

6.96. Guarantee

Besides guarantees required elsewhere, the Contractor shall guarantee the work in general for one year as noted under clause of the Conditions.

All required guarantees shall be submitted to the Engineer In-charge by the Contractor when requesting certification of accounts for payment by the Owner.

6.97. Antiquities

All fossils' antiquities and other objects of interest or value which may be found on the site or in excavating the same during the progress of the work shall become the property of the Owner. The Contractor shall carefully take out and preserve all such objects and shall immediately or as soon as conveniently may after the discovery of such articles deliver the same into the possession of the Owner unclean and as excavated.

If in the opinion of the Engineer In-charge compliance with the provisions of the preceding sub-clause has involved the Contractor in direct loss and/or expense for which he would not be reimbursed by a payment made under any other provision in this contract then the Engineer In-charge shall ascertain the amount of such loss and/or expense, any amount from time to time so ascertained shall be added to the Contract sum, and if an Interim Certificate is issued after the date of ascertainment any such amount shall be added to the amount which would otherwise be stated as due in such certificates.

6.98. Accepted matters

The decision, opinion, direction, certificate (except for payment) with respect to all or any of the matters (which matters are herein referred to as the Accepted matters) shall be final and conclusive and binding on the parties hereto and shall be without appeal. Any other decision, opinion, direction, certificate or valuation of the Owner or any refusal of the Owner to give any of the same shall be subject to any right of Arbitration and review in the same way in all respect (including the provisions as to opening the reference) as if it were a decision of the Engineer In-charge under the following clause.

6.99. Protection and Cleaning

The Contractor shall protect and preserve the work from all damage or accident providing any temporary roof, window and door covering, boxing or other construction as required by the Owner The protection shall be provided for all property adjacent to the site as well as on the site.

The Contractor shall properly clean the work as it progresses and shall remove all rubbish and debris from the site from time to time as is necessary and as directed. On completion, the Contractor shall ensure that the premises and/or site are cleaned surplus materials debris, sheds etc., removed, areas under floors cleared of rubbish, gutters and drains cleared, doors and sashes eased, locks and fastenings oiled, keys clearly labeled and handed to the Engineer In-charge so that the whole is left fit for immediate occupation or use and to the satisfaction of the Engineer In-charge t.

The site shall be kept clean and neat throughout the duration of the construction. Materials which are not required shall be removed from the floors/site at regular intervals. Those materials that are required shall be neatly stacked on the floors/site. Debris will not be allowed to accumulate and shall be regularly removed from the sites.

The Contractor shall provide helmets, safety nets and guardrails at required locations.

6.100. Tolerance

The Contractor shall exercise every care to ensure that all structural members are sufficiently plumb and true to dimensions called for on the drawings to receive prefabricated finishing elements such as doors, windows, cabinet work, ceramic work, concrete, tiles etc. Any variations may require rectification in the structural members or may involve re-making or replacing the finishing elements, fabricated to fit into the openings or spaces, as called for on the Drawings.

In case of separate Contract, the contractor whose work does not conform to dimensions called for, shall be liable for all expenses which may have to be incurred for rectification or replacement as may be required by the Engineer In-charge for the proper installation of the finishing elements. The Engineer In-charge's decision in this respect shall be final and binding on the parties concerned.

6.101. Government Laws

The Contractor shall be responsible for all the rules and regulations of Government and other statutory bodies including labor dispute, Workers' compensation Act or any other acts which may be in force from time to time. The contractor will be responsible for the payment of P.F. Bonus, ESIC, Wages as per Wages Act and any such statutory requirements for their personnel, Workers, Laborers etc.

6.102. Police/Local Authority Management

The contractor shall ensure the smooth execution of the project by adhering to all relevant safety, security, and traffic management protocols. Coordination with local law enforcement authorities is essential to ensure the safety and security of the project site, surrounding community, and all personnel involved.

The contractor shall liaise with local police department and other relevant authorities to establish a communication protocol. Inform the police about major activities or any potential disruptions to the public.

BIT

The contractor shall ensure a sufficient number of trained security personnel to ensure the safety of the site. Ensure that proper safety signage and caution signages across the site surrounding areas to keep the public aware

The contractor shall develop a comprehensive traffic management plan in coordination with local police to minimize disruptions to local traffic. Implement appropriate signage, barriers, and traffic control measures to ensure the safety of both the public and project personnel.

The contractor shall engage with the local community to inform them of the project activities and address any concerns related to safety and security. Establish a one-point contact for local residents and businesses to address concerns.

ANNEXURE – 1
CONSTRUCTION SAFETY MANUAL

1.0 DEFINITIONS

a) "**Contractor**" (Construction or Service) shall mean and include any person or persons contracting to do work at Site i.e., construction projects or for maintenance/repair service work on systems, equipment, etc. The term "Contractor" is used in this document includes all subcontractors performing work under the contract.

b) "**Construction Project**" shall include renovation, demolition, construction, and repair.

c) "**Project Coordinator**" shall mean the Site representative designated in the work contract or hiring employee is the primary contact for the Contractor.

d) "**Safety Officers**" shall mean the safety coordinator(s) who will specifically look into the implementation of different safety and construction waste requirements of the site work. The person designated will in general co-ordinate on matters of safety and in particular ensure that the Safety Manual and Construction Waste Management is complied with. The name of the Safety Officer shall be displayed on the notice board at a prominent place at the work site.

e) "**Site**" refers to BIT' construction Project location.

2.0 SCOPE

a) This document establishes the minimum environment, health and safety requirements for work to be performed by Contractors or Contractor's Personnel at Site.

b) The requirements prescribed in this specification are to protect Site and Contractor's personnel against hazards arising in connection with work, and to prevent accidental damage to property or to the environment.

c) Contractor need to comply with all applicable statutory regulations related to environment, health & safety, construction and contractual work.

3.0 HEALTH, SAFETY & ENVIRONMENT POLICY

a) Every Contractor should prepare a written statement of policy in respect of environment, safety and health of building workers and submit the same for the approval of the competent authority. The intention and commitment should be taken into account in making decisions relating to plant, machinery, equipment, materials and placement of building workers. The Contractor should revise the policy as often as necessary.

b) A copy of the policy should be displayed at conspicuous places in local Language, English and the language understood by the majority of building workers at the construction site.

4.0 SITE SAFETY SET UP

a) Contractor should appoint qualified, experienced and knowledgeable Safety Officer(s) and safety staff (steward(s)) who will communicate, implement and

drive the procedures throughout the work force. Based on the labour force at Site and risk associated with activities, Contractor should appoint sufficient number of skilled & qualified safety staff at Site. If Site representative instructs Contractor to deploy more safety staff or change in existing staff, Contractor should provide/change the same immediately.

b) The Construction Manager or Site engineer appointed by the main Contractor must be totally responsible for compliance with this health and safety code. He must appoint a Chief Safety Officer and form a Safety Committee with the participation of subcontractors or their representatives. This Safety Committee meeting must be held at least once a week and to be chaired by the Construction Manager. The members will include Project Manager and other site supervisors and sub-contractor representative. Site project representative & Owner's safety representative may be invited to attend the meeting as observer. The Construction Manager must take appropriate decision to resolve the issues rose in safety committee meetings and develop action to further improve safety at Site. Safety Committee's weekly report must be submitted to the Site project representative in every Project meeting.

c) Safety stewards should ensure continuous vigilance and enforcement of safety practices at construction Site. Safety steward(s) should continuously observe employees work practices and guide/ coach them to follow safe practices. This process must be in place till the project completion.

d) The provision of various clear instructions/signs (in local language, English and/or language understood by majority of the building workers) will further strength the safety culture. To ensure coordination and cooperation between all Parties involved in the project and to avoid or minimize risk for health, safety and wellbeing during the execution of this project, regular safety committee meeting must be conducted which should review all inspection findings, corrective measures, violations, training requirement and implementation, tool box talk's etc.,

5.0 PROCEDURES

The contractor carrying out high-risk activities like confined space work, working at height, working with High Voltage, deep excavation, hot works, etc. shall submit safe operating procedures. The written procedures must include the following:

- Potential hazards identification,
- Pre-activity meetings,
- Safe working and emergency procedures,
- Work permits / checklists
- List of necessary equipment,
- Training requirements and
- Periodic verification of procedures.

6.0 HEALTH & SAFETY TRAINING

a) Contractor must submit health & safety training plan for their employees that should include type, contents, frequency and refresher training. The Contractor employees training plan must meet regulatory training requirements. The construction worker must be given safety tool box talk every day before starting the work besides scheduled training (attached herewith for reference).

b) Contractor should provide training records, licenses etc. of their employees who will be working on high risk activities such as confined space, fall protection, excavation, hot work, lock out tag out, electrical safety -work on high voltage, scaffold etc. These documents are required to be submitted before starting the work. These documents should be up-dated regularly and the documentation should be maintained at site office.

c) The Site project representative will conduct a start-up meeting with the Contractor prior to all critical work activities. Owner shall have the right to review the documented procedures written by the Contractor and suggest correction if any.

7.0 PLANNING

a) Advance planning for the construction activity is very important to carry out the work safely and efficiently. Often, Contractor gives low priority to planning and especially for health & safety aspects. Improper planning results in unsafe condition and practices at construction Site, which may cause accidents. Site representative can stop the work or terminate contractor employees if such things are not corrected.

b) Contractor must clearly understand that correct tools and safety gear such as scaffold, ladder, portable hand tools, machine guarding, electrical fittings with protective devices, fall protective systems and personal protective equipment (PPE) like safety harness, lanyard, life line, gloves, safety glasses, safety shoes, ear muffs/ear plugs, respirators etc. are made available with sufficient stock at site. A process of issue, replacement person wise and use of PPE to be established and implemented.

8.0 HEALTH & SAFETY EXPECTATIONS / REQUIREMENTS

a) Contractors shall comply with the Site's health & safety expectations as mentioned. Contractor shall also comply with the applicable statutory laws / regulations, codes & standards.

b) It is the requirement of the Contractor to obtain approvals from regulatory agencies for use of DG sets, setting up batching plants etc., and the same to be made available to Owner.

c) The process of managing sewage generated in the site and method to treat it to be specified and followed.

d) Contractors shall maintain a Hazard Identification and Risk Assessment Register (HIRA) in the format provided by BIT which includes Management plans, List of significant risks.

e) This document specifies the minimum environment, health & safety requirements and can be made more stringent depending on type of work hazards involved. The same will be added as an addendum to this specification on review of job operations. These modifications shall be adhered to where provided.

9.0 HEALTH & SAFETY INSPECTIONS & DISCIPLINARY ACTIONS

a) Daily health & safety inspection should be conducted by contractors' safety officer/Project Manager and submit findings to Site project representative. Site representative conduct formal health and safety inspection for each contractor work activities to verify compliance with Site health and safety requirements.

b) All critical equipment, tools & tackles must be inspected using a checklist. Equipment such as scaffold, derrick, and hoist must be erected by trained personnel and should be approved by competent person before use. Other equipment and tools should also be inspected using a checklist. Detailed description for these tools and inspection procedure is given in relevant section of this document. All the targeted inspection findings must be brought to the notice of Site project representative on daily basis.

c) When safety-related problems are noted, the designated Site Contractor's Representative will have the authority to stop work until the problems are corrected. Site will have the right to terminate the contract for safety violations.

d) Follow-up inspections will be conducted to verify the completion of corrective actions.

e) Blatant disregard for health and safety issues or repeated violations will be addressed on an individual basis, which may involve the removal of contractor employees, work stoppage at the cost of the contract firm, or contract termination.

f) All contractor injuries and accidents should be reported & investigated by the contractor, with involvement of Site leader as necessary. The incident reporting should be in **BIT** format only.

g) The contractor will provide the results of the investigation to the Site project representative and implement remedial measures.

10.0 REQUIRED RECORDS / DOCUMENTS SUBMISSION

a) The Contractor shall submit to purchase team copies of the following information:

i) Completed Contractor Safety and Health Qualification Form

ii) Submittals requested based on type of work involved in contractor activity.

iii) Training record of employees working on high & medium hazard activities such as work at height, hot work, confined space entry, excavation, electrical work and from time to time as desired by the HSE

staff based on job hazard review prior to start of work. The refresher training to be given as frequently as needed but not later than six months.

iv) Contractor will be asked to furnish the list of equipment such as scaffolds, staging material, shuttering material, safety net, crane, lift, hoist, tools & tackles, Personal protective equipment etc. All these equipment must meet minimum local/Indian regulation & Indian Standard as the case may be. Non-standard equipment will not be permitted to bring & use at site.

b) Post awarding the contract- contractor must prepare & submit Site-specific construction safety plan and task specific mitigation plan for all high-risk activities. The Site specific construction safety plan should cover following:

i) Hazard identification, Risk Assessment procedures, Risk elimination/ minimization measures and safe operating procedures for all hazardous jobs.

ii) Details of techniques used to check effective implementation of safety measures at shop floor level.

iii) Policy and procedures for selection of PPE, quality assurance of PPE, training on how to use PPE, supply, replacement & inventory at site etc.

iv) Written procedure for high-risk activities like confined space. Lockout & tag out (LOTO), radiation, fall protection, chemical handling, emergency preparedness, etc.

11.0 PRACTICES FOR ENVIRONMENTAL PROTECTION

a) No wastes, liquid, solid, gaseous, sludge, etc., including but not limited to cans, drums, building materials, cleaning agents, etc., whether of Site origin or from material provided by the contractor shall be poured in sink or discharged into sewers or drains, placed in waste containers, dumped on the ground or taken to waste segregating areas without written approval from the Project coordinator or the HSE representative. All wastes shall be segregated and stored properly.

b) Contractor shall inform Site where all wastes of Site origin, for which contractor are responsible for disposal, such as construction debris etc. are to be disposed of. Contractor shall be responsible for determining that the disposal facility has all required permits for disposal of waste materials and shall provide copies of all applicable permits upon request by Site.

c) Contractor shall be responsible for disposal of wastes generated by contractor supplied materials only at permitted facilities and in accordance with all applicable laws and regulations. Contractor shall be responsible to determine that the disposal facility has all required permits for disposal of waste materials, and shall provide copies of all applicable permits upon request of Site.

d) Contractor shall not remove any wastes of Site origin deemed hazardous under laws or regulations. Contractor shall consult with HSE team regarding waste identification.

e) All incidental spills of materials shall be cleaned up immediately; hazardous conditions caused by such spills shall be corrected as soon as possible. All hazardous material Spill Emergencies shall be reported to Site emergency phone number. This applies to "**Spill Emergencies**" that: i) pose an immediate danger to life or health, ii) cannot be handled by workers in the immediate area, or iii) may reach pathways of dispersion (e.g., storm drains, waterways, etc.).

12.0 EMERGENCIES

a) Contractors should familiarize their personnel with fire alarm, exit routes and emergency procedures, including emergency telephone numbers. These numbers and evacuation routes should be displayed at all vantage points Contractor should ensure that proper & sufficient lighting is available at each location workers are working and at each exit route. Exit route should be made clear from obstructions & must be designed to allow free discharge/ exit during emergency.

b) In case of emergency of any kind including fire, medical, security, and release of harmful material to the environment contractor shall contact site's emergency telephone number.

13.0 SECURITY

a) Respective Contractors shall maintain record of every worker entering inside the Site and proper identification should be done either by bar code or daily entry card/photo ID.

b) Firearms, alcohol, and illegal drugs are strictly prohibited on Site property.

c) Photographic equipment cannot be used at Site without prior approval of security.

d) Road blockages by contractor vehicles shall be minimized.

e) Contract personnel who intentionally take or damage Site property shall be handled as per law and criminal charges may be filed if warranted, as determined by Site.

f) All Contractor employees may be frisked when they are entering in and out.

14.0 HEALTH & SAFETY EXPECTATIONS / REQUIREMENTS

a.

a) Basic Safety expectations / requirements:

i) The Contractor shall assume full and independent responsibility for the safety and health of its employees when working at Site and also agrees to perform in full compliance with all applicable laws and Indian standards and requirements.

ii) The Contractor shall not expose Site employees to any unsafe acts or conditions which can be reasonably predicted as hazardous or unsafe or which otherwise violate statutory provisions and Site safety procedures.

iii) Contractors shall perform documented self-inspection(s) of their work operations, facilities and equipment at least once per day for construction projects. Written records shall be maintained of all safety and health inspections made by the Contractors and submit the findings and closure reports to Site on daily basis.

iv) Contractors shall be required to attend a project specific / job orientation meeting organized by the Site Project coordinator (person who hires the services) for the purpose of becoming familiar with this requirement.

v) The Contractor's employees assigned to work at Site will attend an HSE orientation prior to the start of the work, at which environment, safety and health requirements and rules will be discussed. This induction shall be coordinated by the Site Project Coordinator and conducted by the HSE Team.

vi) A Contractor who hires subcontractors, the hiring Contractor shall be responsible for communicating all requirements contained in these documents to the subcontractor.

vii) Contractors shall inform the Site Project Coordinator as soon as possible, not to exceed twenty-four hours, of any accidents that occur at Site involving contractors operations and shall participate in any Site led investigations of that accident.

viii) Contractors shall ensure, to Site's satisfaction, that their employees assigned to Site are physically able to safely perform their assigned tasks.

b) Fall Protection Requirement:

- History of accident reveals that maximum fatalities at construction site are due to falls from height. Considering high risk associated with the activities, Site has serious expectations from the contractor for 100% compliance for zero accident at construction site.
- Falls may result from a number of factors, including unstable working platforms, inadequate engineering controls like guardrails, non-standard ladders, etc., and improper use of fall protection equipment.
- At Site, all activities involving working above 6 feet height are covered under the fall protection requirement in case of construction project. In case of non-construction project, 4 feet height is considered for fall protection.
- Following steps must be followed for all high-risk activities while working at height:

1. Make fall protection part of your workplace safety and health programme
2. Identify/recognize and evaluate fall hazards before allowing worker to work
3. Eliminate fall hazards, if possible.
4. Train workers to recognize fall hazards.
5. Proper use of appropriate equipment like scaffolds or elevated working platform with guardrail, ladder etc. to prevent falls and to protect workers

by encouraging use of approved safety harness with double lanyards, safety net system, etc.

6. Inspect and maintain fall-protection equipment before and after using it.

i) Scaffolds:

- Minimum safety requirements:

1. Only skilled workmen under the supervision of a competent person shall carry out the scaffold erection. Scaffolding erection area shall be cordoned off. 'Do not Use' caution sign should be displayed on incomplete or faulty scaffolding.
2. After completion of the scaffold erection, competent person should check its integrity and stability, using checklist and allow person to work on it if it found safe to work.
3. Competent person should do periodic inspection (at least once in a week) and certify regarding its condition. Inspection record of the same should be maintained in a specified format.
4. All platforms or scaffolds shall have guardrails system. Scaffold without working platform and guardrail system will not be permitted.

- The Working Platform:

1. The working platform should be designed as per the anticipated load.
2. Light duty scaffold: < or = 122 kg/M2 (25 psf)
3. Medium duty scaffold: < or = 244 kg/M2 (50 psf)
4. Heavy duty scaffold: < or = 366 kg/M2 (75 psf)
5. Platform should be made in such a way that there should not be any opening, which allow material to fall. Planks/metal decking of scaffold should be fastened at both ends and it should be laid tight.
6. Proper approach ladder should be provided for scaffolds from the base level to top working platform. Ladder shall be used for climbing up and down.

- The guardrail system:

1. It should be capable of withstanding a force of at least 200 pounds (890 Newtons) applied in any outward or downward direction.
2. In the guardrail system, the edge height of top rails should be 1.0 meter and mid rails should be 0.5 meter above the walking / working platform.
3. Toe boards should be used as protection from falling objects; they must be erected along the edges of the overhead walking or working surface to protect persons working below. Toe boards shall be a minimum of 4.0 inches (10 centimeters) tall from their top edge to the level of the walking/ working surface.
4. Where tools, equipment, or materials are piled higher than the top edge of a toe board, paneling or screening must be erected from the walking/working surface or toe board to the top of a guardrail system's top rail or mid rails, for a distance sufficient to protect employees below.

- Stability & Integrity of Scaffolds:

1. Scaffolds should be erected on surface that can adequately support all loads applied by the scaffolds. Mud and soft soil should be replaced with compacted gravel. Excavation near to the footing of the scaffolds should not be allowed. Proper means to be provided to avoid water penetration to the scaffold footing.
2. Scaffolds erected on any type of soil should have a mudsill of 2 inch x 10 inch plant (full size) and should be continuous under at least two consecutive supports. Do not use blocking or packing such as bricks, short pieces of lumber under scaffold feet.
3. The ratio of height to least lateral dimension should not exceed 3 to 1 (three to one rule) unless the scaffold is 1. Tied to a structure that should be capable of sustaining lateral loads in both tension and compression, 2. Equipped with outrigger stabilizer or 3. Equipped with suitable guy wires.

- Rolling Scaffolds:

1. Height of the tower must not exceed four (4) times the minimum base dimension. Outrigger frames or outrigger units may be used to increase base width dimension when necessary.
2. All casters must be secured to frame legs or screw jacks with a nut and bolt or other secure means. Weight of tower should not exceed the capacity of the casters.
3. Screw jacks must not be extended more than 12 inches above caster base. Tower must be kept level and plumb at all times.
4. Horizontal/diagonal bracing must be used at the bottom and top of tower and at intermediate levels of 20 feet. Fabricated planks with hooks can be used to replace the top diagonal brace.
5. All frames must be fully cross-braced.
6. Casters must be locked at all times, except when the scaffold is in motion.

- Ladders:

1. Competent person should physically verify the condition and confirmation with appropriate Indian Standards at the security gate prior to Site entry. If it is found unsafe to use, it will not be allowed inside the Site.
2. All the ladders used at Site shall be approved by Site Project Coordinator. The approval tag should be displayed all the time while in use.
3. All ladder used at site should be inspected by competent person once in a week and record should be maintained in a defined format.
4. The design of ladder shall confirm to IS 1977. Make shift ladder shall not be permitted. Wooden ladder shall not be permitted at site. For working near or on electrical panel/ equipment only fiber ladder is allowed.

5. Every ladder used should be of good construction, made of sound material and of adequate strength for the purpose for which the ladder or step-ladder is used;
6. No ladder should be used which has a missing or defective rung or a rung which depends for its support solely on nails, spikes or other similar fixing.
7. A ladder should not stand on loose bricks or other loose packing and should have a level and firm footing.
8. Ladders used to gain access to a roof or other area shall extend at least 3 feet above the point of support.
9. The foot of a ladder shall, where possible, be used at such a pitch that the horizontal distance from the top support to the foot of the ladder is one-quarter of the working length of the ladder (the length along the ladder between the foot and the support).
10. Slip resistant shoe, lashing or other effective means shall be used to avoid danger of slipping.
11. Extension ladder should be equipped with metal shackle and adequate locking mechanism.
12. Section ladder over 9.5 m in length should not be used.
13. Bottom and intermediate sections of sectional ladder should not exceed 2 m in length and top section should not exceed 2.75 m in length.
14. Step ladder should have a locking device or spreader to hold two sections firm in open position.
15. Portable platform ladder should be of sound construction and provided with guardrails and toe board for its platform.
16. The worker shall always face the ladder when climbing up or down.
17. Short ladders shall not be spliced together to make long ladders.
18. Ladders shall never be used in the horizontal position as scaffolds or work platforms.
19. The top of a regular stepladder shall not be used as a step.
20. Use both hands when climbing and descending ladders.
21. Metal ladders shall never be used near electrical equipment.

- Personal Fall Protection Systems

- Full body harness and personal fall arrest system

1. All persons working at height of 6 feet or more should wear safety harness and lifeline should be anchored properly. Anchorages used to attach personal fall arrest systems shall be independent of any anchorage being used to support or suspend platforms and must be capable of supporting at least 5,000 pounds (22.2 kilo Newton) per person attached. Lanyards and vertical lifelines must have a minimum breaking strength of 5,000 pounds (22.2 kilo Newton).
2. These consist of an anchorage, lifeline, and a full body harness and may include a deceleration device, or suitable combinations.

3. While working at height where there is possibility of freefall person should use fall arrest system. If a personal fall arrest system is used for fall protection, it must do the following:

a. Limit maximum arresting force on an employee to 900 pounds (4 kilo Newton) when used with a safety belt and limit maximum arresting force on an employee to 1,800 pounds (8 kilo Newton) when used with a body harness;
b. Be rigged so that an employee can neither free fall more than 6 feet (1.8 meters) nor contact any lower level;
c. Bring an employee to a complete stop and limit maximum deceleration distance an employee travels to 3.5 feet (1.07 meters); and
d. Have sufficient strength to withstand twice the potential impact energy of an employee free fall at a distance of 6 feet (1.8 meters) or the free fall distance permitted by the system, whichever is less.

- Safety Net Systems:

1. Safety nets should be installed as close as practicable under the walking/working surface on which employees are working and never more than 30 feet (9.1 meters) below such levels.
2. Defective nets shall not be used. Safety nets shall be inspected at least once a week for wear, damage, and other deterioration.
3. The maximum size of each safety net mesh opening shall not exceed 36 square inches (230 square centimeters) nor be longer than 6 inches (15 centimeters) on any side, and the openings, measured center-to-center, of mesh ropes or webbing, shall not exceed 6 inches (15 centimeters). All mesh crossings shall be secured to prevent enlargement of the mesh opening.
4. Each safety net or section shall have a border rope for webbing with a minimum breaking strength of 5,000 pounds (22.2 kilo Newton). Connections between safety net panels shall be as strong as integral net components and be spaced no more than 6 inches (15 centimeters) apart. Safety nets shall be installed with sufficient clearance underneath to prevent contact with the surface or structure below. When nets are used on bridges, the potential fall area from the walking/working surface to the net shall be unobstructed.

- Electrical Hazards Control:

i) Electricity is extensively used in the construction site for various purposes such as driving machinery, lifting machines, motors providing general lighting, operating hand tools etc., Electricity is not dangerous, if used properly. However, if used unwisely, serious accidents can occur.
ii) LOTO procedure should be strictly followed as per the Site LOTO procedures.
iii) All electrical distribution boards should be equipped with MCB, ELCB / RCC. All temporary installations at a building or other construction work should be provided with earth – leakage circuit breakers (ELCB). All portable

electrical tools shall have double insulation and shall have upstream protection by earth leakage circuit breaker (ELCB) of less than or equal to 30 Milli Ampere rating and miniature circuit breaker (MCB).

iv) Any electrical connection should be taken, maintained and repaired by a qualified electrician with use of appropriate insulated tools and necessary PPEs.

v) Temporary electrical wiring used for lights and power shall comply with the Indian electricity rules. All temporary electrical wiring installations, tie-ins and pick-ups shall be approved by the Site Project Coordinator. All temporary electrical cables should be amour/metal sheathed cable to protect it from the cut due/mechanical damage.

vi) All portable lights for use in confined areas like manholes, or damp areas shall be operated at a maximum of 24 volts or protected by earth leakage circuit breaker (ELCB) and miniature circuit breaker (MCB).

vii) At the construction work where the exact location of underground electric power line is not known, the building workers using jack hammers, crow bars or other hand-tools which may come in contact with a live electrical line, should be provided by the contractor with insulated protective gloves and foot-wear of the type in accordance with the BIS standards.

viii) The contractor should ensure that all electrical appliances and current carrying equipment used at a building or other construction work are made of sound material and are properly and adequately earthed. All electrical appliances should be provided with a local isolation switch close to the appliance.

ix) The contractor should ensure that all electrical installations are protected from rain.

x) The National Indian electric codes and regulations should apply to all permanent and temporary electrical installations.

xi) All current carrying parts should be enclosed and enclosure should be earthed properly.

xii) When high structures are moved under electrical lines, proper clearances as required should be maintained.

- Tools & Equipment:

i) All power tools equipment like portable grinder, drilling machine, saw, welding machine are to be checked at Site security gate by competent person for its conditions as per the checklist approved **by BIT**. Only those tools, which are found safe and having LOTO capability are allowed inside the Site.

ii) Hand and power tools must be maintained in a safe condition. When power-operated tools are designed to accommodate guards, they must be equipped with appropriate guards when in use. All moving / rotating parts must be provided with 360 degree guarding.

iii) All hand-held pneumatic power tools must be equipped with a constant pressure switch that shuts off when the pressure is released. Pneumatic power tools must be secured to the hose or whip by positive means. Safety

clips or retainers must be maintained on pneumatic impact (percussion) tools to prevent attachments from being accidentally expelled. Hoses should not be used for hoisting or lowering tools and hoses exceeding ½" in inside diameter must have a safety shutoff at the source of supply to reduce pressure in case of a hose failure.

iv) Abrasive wheel machine should not be operated more than the manufacturer's recommended speed. All employees using abrasive wheels must have eye protection and other tools must be operated using appropriate personal safety equipment.

v) Electric power-operated tools should be of the approved double insulated type, or grounded in accordance with good electrical practice. It should have upstream protection through ELCB having rating not more than 30 mA. Electric power operated tools should not be lowered by holding its power chord. Use only BIS standard hand power tools

vi) Lifting machines tools and lifting tackles must have valid competency certificate for use inside Site. The contractor shall have register/record maintained for inspection of lifting machines tools and lifting tackles.

vii) Cranes, forklifts shall have valid test certificate from competent authority and prior HSE visual examination is required before entering the premises and then permission for entry will be based on the judgment of HSE expert.

- Chemical Management:

i) Any chemical brought inside the Site should have material safety data sheet

ii) All containers shall be properly labeled with name, manufacturer's name, hazard warning symbol and PPE and always properly caped, when not in use. All chemical container should be stored in a secondary container

iii) Workers using chemical must be trained & well versed with the hazards & precaution to be taken during the use & during emergency. Require antidote, safety kit must be made available.

iv) Flammable or combustible liquids shall not be stored in areas used for exits, stairways or normally used for the safe passage of pedestrian or vehicular traffic.

v) Inventory of combustible materials shall be kept at a minimum as reasonably practicable and other combustible material shall not be allowed to accumulate to the extent of creating a fire hazard.

vi) The Contractor shall be responsible to clean the site and handle the waste generated by his work activities and dispose off properly in environmental friendly manner outside the premise. The disposal site must be approved by competent authorities.

- Gases / Gas Cylinder management:

i) All compressed gas cylinder should be handled in an approved cylinder trolley. No free rolling of cylinders is allowed at Site.

ii) Compressed gas cylinders shall be properly and legibly marked with the trade name of the gas content and also colour coded as per Bureau of Indian

Standard. When transporting, moving and storing compressed gas cylinders, valves shall be closed, and protection caps shall be in place and secured. For transportation of gas cylinder specifically designed trolleys must be used.

iii) Cylinder shall not be rolled for transporting from one place to another place. All cylinders shall be secured in an upright position by chains or other approved means to prevent them from accidentally falling.

iv) Oxygen cylinders shall be stored separately from fuel gas cylinders. No compressed gas cylinders shall be taken into confined spaces.

v) Overnight storage of cylinders of compressed flammable gases or oxygen inside buildings shall not be permitted without the prior approval of the Site Project Coordinator. Cylinders so stored shall have valves closed, regulators removed, have caps replaced, and be placed in an approved location.

vi) Gas cylinders shall be stored in an area assigned by the Site Project Coordinator. This area shall be well ventilated and away from sources of ignition or heat.

- Welding & Gas Cutting Operation:

Welding and Gas cutting operation is high-risk job and should not be done without hot work permit. Area should be cleaned and free from any combustible material where welding / gas cutting operation to be carried out.

i) Welding Operation

- Any welding machine prior to use first time should be inspected and certified for its safe use by a competent person. All welding machine should be inspected as per the checklist for its condition once in a week and proper inspection tag should be placed on the machine.
- Only qualified welder is allowed to do welding with appropriate insulating hand gloves, appropriate welding shield and tools.
- Power to welding machine should be taken through ELCB. Welding machine should be earthed properly. Before shifting welding machine from one place to another power supply should be switched off.
- A portable screen should be used around the welding work area to prevent unnecessary exposure to people working in the vicinity.
- Sparks/hot melt should be contained by providing fire blanket / aluminum sheet barricading. Power cable and return cable should be taken up to the welding place i.e. any structural member / pipeline should not be used as return current cable.

ii) Gas cutting operation

- Gas cutting nozzles should be equipped with flash back arrester. Appropriate and ISI marked gas regulators are only allowed for Oxygen & Acetylene gas cylinder.
- Gas cylinder should not be exposed to sparking / heat. Acetylene cylinder should always be kept vertical position. Oxygen & Acetylene gas cylinders should be placed in cylinder trolley, free standing is not allowed.
- Site Chemical & Gas handling procedures should be strictly followed for handling, storage and uses of gas cylinders.

- Inventory of gas cylinders should be kept as minimum as possible. Cylinder valve should be protected with secured valve cap. Free rolling of the cylinder is not allowed. Magnetic lifting of cylinder is not allowed.

- Motor Vehicle & Earth Moving Vehicle - Site Transport Safety:

i) Contractor should ensure that all vehicles used at construction site comply with the requirements of the Central Motor Vehicles Act, and the rules made there under.

ii) Contractor should also ensure that a driver of a vehicle of any class of description operating at a construction site holds a valid driving license under the Motor Vehicles Act/Rules.

iii) All vehicles that are used on construction site must be in fit condition and should carry proper fitness certificate. Before entering Site, all vehicles should be checked for condition, driver license, brakes and other controls, lights. Checklist given by Site should be complied before allowing any vehicle at Site

iv) Many accidents at work places are caused by undue haste or short-cut methods in executing work. Vehicle should follow speed limit (20 kmph) and defined routes only. No vehicle should be allowed unattended in ON condition or keeping start key in position.

v) Electric supply lines, telephone lines and water supply lines normally go along the road side and cannot be protected at all times. Careless driving can disturb these essential services. The driver should be specifically instructed to avoid any damage to these essential services.

vi) Vehicle should be loaded as per the loading capacity specified by the manufacturer. Any vehicle that is overloaded will not be permitted within the Site construction site

vii) Protective embankments should be provided at all excavation sites. They are particularly necessary where Lorries or dumpers trip into excavations. Stops made of bulk timbers of about 300 mm square, securely anchored, are normally used for this purpose. Care must be taken to ensure that the timbers are moved and relocated as necessary when the work proceeds.

viii) The design and placement of overhead barriers as well as storing of metallic objects should be at a safe distance from the overhead lines. Where no work is done under the overhead lines nor any traffic or plant pass under them, the barriers should prevent inadvertent close approach. Where the work or traffic flow is under the overhead lines, defined access ways should be laid out. If work is done beneath the lines, expert advice for additional precautions should be obtained from the local electricity authorities, recorded and complied with.

- Overhead Protections:

i) Every contractor should ensure that overhead protection is erected along the periphery of every building under construction that should be of fifteen metres or more in height when completed.

ii) Safety net or other means should be provided overhead protection

iii) The contractor should ensure that any area exposed to risk of falling material, articles or objects should be roped off/ cordoned off /suitably guarded from inadvertent entry of person other than building workers permitted to enter these areas.

- Slipping, tripping, cutting, drowning and falling hazard control:

i) All passageways, platforms and other places of construction work at the building or other construction work should be kept free from accumulations of dust, debris or similar materials and other obstructions that may cause tripping.

ii) Any sharp projections or protruding nails or similar projections which may cause cutting hazard to a worker should be removed or otherwise made safe by taking suitable measures by the contractor. Additional precaution has to be exercised by the contractor in handling and laying the reinforcement bars. There should not be any protruding reinforcement bars without adequate measures to make it safe.

iii) Contractor should not allow any building worker to use the passageway, scaffolds, platform or any other elevated working surface, which is in a slippery and dangerous condition. He should ensure that water, grease, oil or other similar substances which may cause the surface slippery, be removed or sanded, saw dusted or covered with suitable material to make it safe from slipping hazard.

iv) Wherever building workers are exposed to the hazard of falling into water, they should be provided by adequate equipment for saving themselves from drowning and rescuing from hazard. Wherever overhead or underground water tanks are in the construction site, measures has to be taken by the contractor in making these places safe by providing appropriate signage's, barricades and restricting the use of these areas by all workers. The contractor should have a tailor made permit system designed and implemented for regular maintenance and cleaning of these areas.

v) Every open side or opening into or through which a building worker, vehicle or lifting appliance or other equipment may fall at a building or other construction work should be covered or guarded suitably to prevent fall except where free access is necessary by reason of the nature of the work.

vi) Wherever building workers are exposed to the hazards of falling from height while employed on work, they should be provided with adequate equipment or means for saving them from hazards. Equipment or means should be in accordance with the BIS Standards or as approved by the competent authority.

vii) Whenever there is a possibility of falling of any material, equipment on building worker at a construction site, adequate and suitable safety net should be provided by contractor in accordance with the BIS Standards or as approved by the Competent authority for preventing any injury or hazards.

- Fencing / Guarding of moving parts:

i) Every contractor should obtain formal approval from Site -Project authorities before bringing any equipment having moving parts into the site. These equipment should have clear specification, name plate and operation manual furnished by the manufacturer. Standard operating procedures for these machines should be submitted to Site-project authorities and formal clearance obtained before installing and trial run.

ii) All motors, cogwheels, chains, and friction gearing, flywheels, shafting, dangerous and moving parts of machinery (whether or not driven by mechanical power) should be securely fenced or lagged

iii) Fencing of dangerous parts of machinery should not be removed while machinery is in motion or in use

iv) Contractor should develop equipment specific LOTO procedure for all critical equipment, electrical distribution boxes, junction boxes etc.,

v) No part of any machinery which is in motion and which is not securely fenced should be examined, lubricated, adjusted or repaired except by a person skilled for undertaking examination, lubrication, adjustment or repairs

vi) Any activity mentioned above should be undertaken by a trained and responsible person by applying LOTO procedure.

vii) When a machine is stopped for servicing or repairs, adequate measures should be taken to ensure that these machines do not restart inadvertently. LOTO procedure should be followed.

- Lifting appliances:

- All lifting appliances, including their parts and working gear, whether fixed or moveable and any plant or gear used in anchoring or fixing of appliances, should confirm appropriate Bureau of Indian Standards and be of sound construction, sound material, and of adequate strength and maintained in good working condition.
- Every lifting appliance should be provided with adequate and efficient brakes /control measures. Test and periodical examination of lifting appliances by authorized third party certification.
- All lifting appliances including all parts and gears, whether fixed or moveable, should be tested and examined by a competent person in the following circumstances:

1. before being taken into use for the first time
2. after it has undergone any alterations or repairs liable to affect its strength or stability
3. or after erection on a construction site

- All lifting appliances should be thoroughly examined by a competent person once at least in every twelve months and the record of examination should be maintained.

- Automatic safe load indicators

1. Every crane, if so constructed that the safe working load may be varied by raising or lowering of the jib, should be attached with an automatic indicator of safe working loads which give a warning to the operator wherever the load exceeds the safe working load
2. Cut-out should be provided which automatically arrests the movements of the lifting parts of every crane if the load exceeds the safe working load, wherever possible.
3. In case it is not possible to install an automatic safe load indicator, in which case, provision of a table showing the safe working loads at the corresponding inclinations or radii of the jib on the crane will be considered sufficient.

- Identification and marking of safe working load

1. Every lifting appliance and loose gear should be clearly marked for its safe working load and identification by stamping or other suitable means;
2. Every derrick (other than derrick crane) should be clearly marked for its safe working load.
3. The lowest angle to the horizontal, to which the derrick may be used, should be legibly marked;
4. Every lifting appliance having more than one working load should be fitted with effective means to enable the operator to determine safe working load at each point under all condition of use.
5. No lifting appliances or lifting gear should be used unless marked as per BIS provisions.

- Operation of lifting appliances

1. Every crane driver or lifting operator should possess adequate skill and training in the operation of the particular lifting appliance;
2. Person above eighteen years of age should be in control of any lifting appliance, scaffold winch, or to give signals to the operator;
3. Precaution should be taken by the trained operator to prevent lifting appliance from being set in motion;
4. The operation of lifting appliance should be governed by signals, in conformity with the BIS standards;
5. The lifting appliance operator's attention should not be distracted while he is working;
6. No crane, hoist, winch or other lifting appliance or any part of crane, hoist, winch or other lifting appliance should not be loaded beyond the safe working load, unless used for testing purpose in the presence of competent authority;
7. During the hoisting operations effective precaution should be taken to prevent any person from standing or passing under the load.
8. Operator should not leave lifting appliance unattended while power is on or load is suspended.

9. No person should ride on a suspended load or on any lifting appliance;
10. Every part of a load in course of being hoisted or lowered should be adequately suspended and supported to prevent danger;
11. Every receptacle used for hoisting bricks, tiles, slates or other material should be suitably enclosed so as to prevent the fall of materials;
12. The hoisting platform should be enclosed when loose materials or loaded wheel-barrows are placed directly on platform for hoisting or lowering of materials.
13. There should not be sudden jerk to any lifting appliances while the material is being raised, lowered or slowed.
14. In hoisting a barrow, any wheel of barrow should not be used as a means of support unless adequate steps are taken to prevent the axle of wheel from slipping out of its bearings;
15. Long objects like planks or girders should be provided with a tag line to prevent any possibility of danger while raising or lowering.
16. During the process of landing of material, a building worker should not be permitted to lean out into empty space for finding out the loading and unloading of material;
17. The hoisting of loads at places where there is regular flow of traffic should be carried out in an enclosed space. In case it is impracticable, suitable measures are to be taken to hold up or divert the traffic during the time of hoisting
18. Adequate steps should be taken to prevent a load, in the course of being hoisting or lowered from coming into contact with any object to avoid any displacement.
19. Appliances should be provided and used for guiding heavy loads when raising or lowering heavy loads to avoid crushing of hands.

- Tower Cranes

1. Tower cranes should be operated by trained operator capable of working at height. The operator should also be trained in using full body harness system.
2. The ground on which a tower crane stands should have adequate bearing capacity;
3. Bases for tower cranes should be firm and levelled and cranes should be erected at a reasonably safe distance from excavations. These cranes should be operated within gradient limits as specified by the manufacturer of cranes;
4. Tower cranes should be sited where there is a clear space available for erection, operation and dismantling of cranes;
5. Tower cranes should be sited in a way that the loads on cranes are not handled over any occupied premises, public thoroughfares, near power cables, other than construction works for which such cranes are intended
6. Where two or more tower cranes are sited and operated, every care is taken to ensure positive and proper communication between operators of cranes to avoid any danger or dangerous occurrences;

7. The instructions of the manufacturer of a tower crane and standard safe practices regarding cranes should be followed while operating or using crane.
8. **The Tower crane installation, jumping operation and operating procedure must** be **submitted for review. Trained crew having 5+ years experience should be engaged in installation & jumping operation of the tower crane.**
9. **During installation of power crane, the area must be barricaded & inspection has to be made with checklist before operating the crane.**

- Personal Protective Equipment (PPE):

1. Personal Protective equipment are barrier between the person and the hazard. These provide adequate protection, when selected properly and used and maintained in accordance with the manufacturers guidelines. A proper hazard assessment therefore is a must before selecting/stipulating a PPE.
2. Personal protective equipment are not a foolproof safety system and therefore, more emphasis should be given on engineering & administrative controls to eliminate or minimize the hazards. All efforts must be made to free from trip hazards.
3. Effort to minimize the hazard must be adequate & appropriate. All necessary personal protective equipment must be Indian standard as a minimum & approved by Site HSE Staff should be available for use of persons employed on the site and maintained in a condition suitable for immediate use, and the contractor should take adequate steps to ensure proper use of equipment.
4. All contractor workers (all persons hired by contractor/subcontractor) should wear minimum PPE that are Safety Helmet, Safety Shoes and Safety glasses without fail while working at construction site.
5. Workers should be trained in proper use of PPEs. They should be taught pre-use inspection, storage & maintenance of PPEs.
6. Contactor should maintain PPE store at construction site. Sufficient stock of PPE should always be maintained at site. Safety Steward should ensure that right type PPE issued to worker according to the need of protection against the hazard.

- Non Respiratory Personal Protective equipment

1. Head Protection

The personal protective equipment available for the protection of head is the safety helmet or hardhat. It is primarily designed to protect the worker's head from knock caused by impact, falling objects and even electricity. The brim of the helmet offers protection to the eyes and face.

Contractor should ensure that all workers entering in Site construction site wear safety helmet without fail. The helmet should be ISI marked and should be provided by the contractor to people working at construction site.

2. Eye and face protection

Suitable goggles or effective screen should be provided for the protection of eyes of persons employed in the process, which involves the following activities:-

- Dry grinding of metals by a revolving wheel or disc driven by mechanical power
- External or internal turning of non-ferrous metals.
- Welding or cutting of metal by means of an electrical, oxy-acetylene or similar process.
- Breaking or dressing of stone, concrete.
- Handling and working with substances of a corrosive nature such as acids, alkalis, chemicals and removing agents
- Blasting work where grit, high-pressure water jets or other materials are used for cleaning and removing rust, scale, paint, etc.
- Any work where paints, paint compounds and chemicals are applied on the surface by means of spraying/brushing.
- Any other work as suggested by Site representative

  Note: Any person assisting or in the vicinity of the above-said processes, are also required to wear eye and face protection.

3. Hand and arm protection

Accident statistics reveal that the fingers and hands are the most frequently injured parts of the body. In order to avoid accidents to fingers and hands, every building worker engaged in handling sharp objects or materials which may cause hand injury, should be provided with suitable hand-gloves by the contractor, in accordance with the BIS standards. The employees should wear protective equipment like gloves, gauntlets, hand pads, etc. The selection of gloves should depend on the nature of work and the risk involved.

Competent person should ensure that appropriate hand gloves issued to people which give protection against the hazard, which he/she is likely to expose. People should also be trained about different type of hand gloves, the hazard against which it gives protection and proper use of the hand gloves.

4. Foot protection

Injuries to the foot are mainly caused by the falling of materials while handling or by the foot striking against materials or objects. Safety shoes with steel toecaps protect the toes from falling objects and striking against objects. The steel inner sole affords protection against protruding nails or sharp objects. In addition to the use of safety shoes, foot gaiters should be worn while carrying out welding and cutting operations.

Every building worker required to work in water or in wet concrete or in other similar work at a building or other construction work, should be provided with suitable waterproof boots by the contractor.

5. Body Protection

Workers likely to be exposed to corrosive or other harmful substance should wear appropriate body protection. Every building worker required using or handling alkalis, acid or other similar corrosive substances at a building or

other construction work should be provided with appropriate protective equipment by the contractor, in accordance with the BIS.

Every building worker required to work in rain or in similar wet condition at building or other construction work, should be provided with waterproof coat with hat by the employer.

6. Protection against falling from heights

Where any person is required or allowed to work at a place from which he may be liable to fall through a distance of 6 feet or more, he should be provided with full body harness system. This is the secondary safety measure. It should not be taken as substitute of engineering control like proper working platform with railing, guardrails, etc.

Full body harness should be ISI marked as a minimum and confirm Bureau Indian Standards requirements. Test certificate issued by the manufacturer should be maintained at site.

A competent person should inspect full body harness system at least once in every 3 months and the record of inspections should be maintained. Every worker is to be trained regarding proper use of full body harness and condition checks of it. Person working at height should be instructed to do condition check of full body harness prior to use. Use of full body harness with double lifeline should be encouraged while working on scaffolding, roof, edge of building, etc.

Safety net and its use: **Every safety net should be of adequate strength, made of sound material and should be suitable for use and conforms to the BIS standard;**

Responsible person for maintenance of safety nets and its use should ensure safe fixing of safety nets and provide safety nets with suitable and sufficient anchorage so that the purpose for which safety net is intended for use, is served.

7. Hearing Protection

To protect the ear (hearing ability) from industrial noise, the following types of protective devices should be used:-

- **Earplug**

  The earplugs are usually made of soft rubber or PVC materials. The noise reduction obtainable by the use of ear plugs ranges from 15 dB(A) to 20 dB(A), provided it is used as per manufacturer's recommendation.

- **Ear Muff**

  The effectiveness of the earmuff depends upon the size, shape, seal materials and the type of suspension used. Earmuff gives a better protection than earplug. The noise reduction obtainable by the use of earmuffs ranges from 30dB(A) to 40dB(A), provided it is used as per manufacturer's recommendation.

  The contractor should ensure that all people who are exposed to noise should be provided with either earplug or earmuff and ensure its uses by people at work.

- Respiratory Personal Protective Equipment

When the working atmosphere is contaminated by dust, fumes and gases, suitable respiratory equipment should be used. There are number of respiratory protective equipment available for various types of operations carried out. The selection of respiratory equipment should be based on the nature of contaminant, the period for which the protection is required, concentration of the contaminant and the restriction of movement in the work area.

- **Dust Respirator**

  Dust respirator should be used for protection against dust particles in the air. It is usually attached to half-face mask, containing filter paper or cotton, which screens fine particles of dust from the inhaled air. These dust respirators should not be used in an area where oxygen deficiency is noticed, or toxic gas or vapor present.

- Housekeeping:

  Safety is related to good housekeeping. It includes the following:

- Working premises is clean and tidy.
- Passage ways marked and clear of all obstructions.
- Material well stacked and neatly placed.
- No dangling of electric or phone wires at construction sites.
- Roads clean, well watered and well drained
- Environment well lit, particularly during the night shift

  Contractor has to ensure that adequate resources and processes are deployed for maintaining good housekeeping at all times. This should include deployment of housekeeping squad for daily removal of unwanted material such as metal support members, shuttering forms, scaffolds, nails, construction debris etc. This can be done by properly organizing construction steps.

  Contractor must ensure that proper access is established for material and manpower movement. Daily inspection teams should be in place for inspecting each area of construction site for checking all passage ways, access, emergency exit, etc., appropriate signage should be installed.

  A permanent dedicated housekeeping team in proportion to the size of the project to be deployed at the site for regular housekeeping activities.

❖ **Tips for maintaining good housekeeping within the premises**

- All working places, working rooms, passages, storerooms, office rooms, etc., should be kept in clean and hygienic condition.
- The floor of every working room and other places should be maintained clean and as far as practicable dry and non-slippery.
- All toilets, washbasins, drinking water points etc., should be maintained in hygienic condition.
- Adequate number of waste containers should be provided in all the places and these should be emptied periodically.
- Supervisors should ensure that the employees are properly instructed to maintain good housekeeping in their respective areas.
- Any spilled oil, grease, acid or alkaline materials, should be cleaned immediately.

- Access to safety and firefighting equipment, electrical control panels, and safety showers should be kept clear.
- Passages, walkways, staircases, etc., should not be obstructed.
- No pipes, hoses, etc., should be run across pathways.
- Materials with protruding nails/sharp edges should not be left lying around.

❖ **Disposal of Debris**

- Debris should be handled and disposed of by a method which does not cause danger to the safety of a person and is in adherence to legislations where applicable.
- Debris should not be allowed to be accumulated so as to constitute a hazard
- Debris should be kept sufficiently moist to bring down the dust within the permissible limit;
- Debris should not be thrown inside or outside from any height.
- On completion of work, left over building material, article or other substance or debris should be disposed of as soon as possible to avoid any hazard to any traffic or person.
- Debris should not be disposed outside the Site without prior approval of Site HSE Team
- Stacking and Un-stacking of materials and articles:

i) All building materials should be stored or stacked in a safe and orderly manner to avoid obstruction of any passageway or place of work; care should be taken to ensure that emergency exits are not blocked by any materials.

ii) Material piles are stored or stacked in such a manner so as to ensure stability;

iii) Material or equipment should not be stored upon any floor or platform in such quantity so as to exceed its safe carrying capacity;

iv) Material or equipment should not be stored or placed so close to any edge of a floor or platform so as to endanger the safety of persons below or working in the vicinity.

v) Where stacking, un-stacking, stowing or un-stowing of construction material or article, or handling cannot be safely carried out unaided, all measures to guard against accident or dangerous occurrences should be taken by shoring or otherwise to prevent any danger likely to be caused by handling;

vi) Stacking of material or article should be made on firm foundation not liable to settle and deviate, material or article should not overload the floor on which stacking is made;

vii) The material or articles, should not be stacked against partition or walls of a warehouse or stores place unless it is proved that partition or the wall is of sufficient strength to withstand the pressure of materials or articles;

viii) The materials or articles should not be stacked to a height and in a manner so as to render the pile of stack unstable and cause hazards.

ix) Where the building workers are working on stack exceeding 1.5 meters in height, safe means of access to the stack should be provided;

x) All stacking or un-stacking operations should be performed under the supervision of a responsible person.

xi) Stacking of construction materials or articles should not be made near the site of excavation, shaft, pit or any other opening;

xii) Stacks that may lean heavily, unstable or may be likely to collapse should be barricaded.

xiii) All racks used for stacking must be grouted and anchored to prevent fall or collapse.

❖ Stacking of cement and other materials

- A stack pile should not be more than ten bags in height unless stack pile is stacked in a suitable enclosure or otherwise adequately supported;
- While removing bags from the stack pile, the stability of stack pile should be ensured;
- Bags containing cement or lime should be stored in dry places;
- Materials like bricks, tiles or blocks should be stored on a firm ground;
- Reinforcing steel should be stored according to its shape, size and length;
- Stack of reinforcing steel should be kept as low as possible;
- No pipe should be stored on rack or in stack where pipes are likely to fall by rolling;
- The angle of repose should be maintained where loose materials are stacked;
- When dust laden material is to be stored or handled, measures should be taken to suppress the dust produced by storing or handling by adopting suitable means.

  The building workers working for storing or handling should use appropriate personal protective equipment.

- Stability of Structure:
  The contractor should ensure that any wall, stack, chimney or other structure or part of a structure should not be left unguarded in situations or conditions that the wall, chimney, stack or other structure may fall, collapse or weaken due to wind pressure, vibration or due to any other reason.

- Lifting and carrying of excessive weight:
  Contractor should comply with the following guidelines for lifting and carrying of articles in the construction weight:
- Worker's should not lift any material, article, tool or appliances by hand or carry overhead or over his/her back or shoulders exceeding in weight the maximum limits shown below unless aided by any other building worker or a mechanical device.

Person	Maximum Weight Load
Adult – man	50 Kg.
Adult – woman	30 Kg.

- No building worker aided by other building workers, should lift by hand or carry overhead or over their back or shoulders, any material, article, tool or appliance exceeding in weight the sum total of maximum limits set out for each building worker separately as indicated above, unless aided by a mechanical device.

- Illumination of Passageways, etc.:
  The contractor should ensure that illumination sufficient for maintaining safe working conditions at a site of a building or other construction work is provided where building workers are required to work or pass and for passageways, stairways and landing, such illumination should not be less than that provided in the BIS standards. While working at height, shadow and glare effect should be minimized as it may result in fall accidents.

- Concrete Work:

i) Any building worker handling cement or concrete should –

- Wear close-fitting clothing, gloves, helmet or hard hat, safety goggles, proper footwear and respirator or mask to protect him/her from danger of handling;
- Keep as much of his/her body covered as is required to protect him/her from danger of handling;
- Takes all necessary precautions to keep cement and concrete away from his/her skin in handling.

ii) Formwork and shores used for concrete work should be structurally safe and should be properly braced or tied together so as to maintain position and shape of formwork or shores;

iii) Moving parts of the elevators, hoists, screens, bunkers, chutes, grouting equipment used for concrete work, other equipment used for storing, transport and handling ingredients of concrete should be securely fenced to avoid contact of workers with moving parts.

iv) Screw conveyers used for cement, lime and other dusty materials should be completely enclosed.

v) Concrete buckets used with cranes or aerial cableways should be free from projections from which accumulations of concrete could fall;

vi) Movements of concrete buckets should be governed by signals necessary to avoid any danger by movements.

vii) A scaffold carrying a pipe for pumping/pumped concrete should be strong enough to support the pipe at time when pipe is filled with concrete or water or any other liquid and in addition bear all the load of workers who may be on scaffold, safely;

viii) Vibrator used in concreting work should be operated by a building worker, who is in good physical condition.

ix) All practical measures should be taken to reduce the amount of vibration transmitted to the operators working in concreting work. Workers operating vibrators should use appropriate PPEs

x) When electric vibrators are used in concreting work, vibrators should be earthed, the leads of vibrators should be heavily insulated and the current should be switched off when vibrators are not in use.

- Work on steep roofs:

i) All practicable measures should be provided to protect the building workers against sliding when carrying out work on steep roofs.

ii) All crawling boards used for work on steep roofs should be of adequate strength, made of sound material and of the type approved for the purpose of their use as per BIS standards;

iii) Crawling board should be kept in good repairs and inspected by a responsible person before being taken into use;

iv) Crawling board should be secured to a steep roof on which it is used by ridge hooks or other effective means;

v) A firmly fastened life line of adequate strength should be strung beside each crawling board throughout its length while using crawling boards.

vi) Person working on steep roofs must be physically fit and wear fall protection devices.

- The pressure equipment:
  The pressure equipment used for pressure testing of pipes, hydraulic pump system, compressed air system, etc. should have -
- A suitable safety valve or other effective device to provide maximum safe discharge pressure from being exceeded at any time;
- A suitable pressure gauge with a dial range not less than 1.5 times and not exceeding twice the maximum working pressure, easily visible and designed to show at all times, the internal pressure in kilogram per square centimeter and marked with the maximum safe working pressure on the dial of equipment;
- A suitable stop valve or valves by which the pressure plant or the system of the pressure plant may be isolated from the source of supply of pressure or otherwise;
- Every pressure plant or equipment should be thoroughly examined by the competent person –

1. Externally, once in every period of six months;
2. Internally, once in every period of twelve months and;
3. By hydraulic test once in a period of four years.

The contractor shall submit the test certificates in Form 7 (in respective states) to Site-representative

- Safety signs & Posters:
  Safety signs & Posters should be displayed at conspicuous locations to make people aware about particular hazard. Safety signs used in the Premises should be in English, Hindi, Local language or in the language which is understood by maximum number of workers.
- **General Safety Signs**

a) Warning Signs
b) Mandatory Signs
c) Prohibition Signs
d) Safe Condition Signs
e) Fire Fighting Equipment Signs
f) Supplementary Safety Signs

- **Work Process Safety Signs**

1. Hot-work in progress
2. Testing of heating coils in progress
3. Dismantling of pipelines/valves in progress
4. Chemical cleaning in progress
5. Transferring of fuel oil in progress
6. Fuel vent pipe
7. Painting in progress
8. Radiography work in progress
9. Grit blasting in progress
10. Beware! Wire across road
11. Fit for entry

- Health & Hygiene arrangement at site:
  Contractor should ensure that basic hygienic arrangement provided at site sufficient to the people employed at site. Minimum arrangements required under BOCW Rules 2006 should be made by the contractor.
- Latrine and urinal arrangements – It should be separate for man & woman workers. It should be sufficient in numbers to accommodate total persons at site.
- Canteen or proper arrangement where workers can take their food.
- Washing Facilities ---In every construction site adequate and suitable facilities for washing should be provided and maintained for the use of workers employed. Facilities should be conveniently accessible and should be kept in clean and hygienic condition.
- Drinking water facility should be arranged for the drinking water need of the workers employed at site.
- Provision of shelter during rest - Suitable sheds two for meals and other two for rest separately should be provided for the use of men and women labour.
- First Aid centre & Emergency Medical Facilities:
  Medical examination of building workers, etc:
- Any building worker who is employed for a work involving risk or hazards should be medically examined at intervals as per the direction of the competent person. Ex:-Vertigo test for workers working at height, etc.,
- Every operator of a crane, winch or other lifting appliance, transport equipment or vehicle, should be medically examined before employing operator and again periodically, at intervals as the competent person may direct.

- The medical examination should be conducted as per the stipulations and should be conducted by medical officers or at hospitals, which are approved by the State Government for the purpose.
- The record of the medical examination of all building worker should be maintained in a register of prescribed format. Register should be made available in the site.

  Occupational Health Centre (First Aid Centre) should be provided at site to take care of first aid injury. All necessary medicines and other aids should be available as per the BOCW Requirement. First Aid Centre should be maintained by trained and qualified first aider(s).

  Contractor should provide ambulance van at site to take care of any medical emergency at site. The ambulance van should be equipped with necessary emergency medical equipment.

  Stretcher and other emergency rescue equipment should be available at site.

- Fire Safety:

  Contractor should ensure that construction site is provided with –
- Fire extinguishing equipment sufficient to extinguish any probable fire at construction site;
- Adequate water supply at the site for fighting fire
- Number of trained persons required to operate the fire extinguishing equipment
- Fire extinguishing equipment provided should be properly maintained and inspected at regular intervals (every week) by the responsible person and a record of such inspections should be maintained
- **General Fire Safety Precautions:**
- Work Permit system checklist to be followed at construction site
- Only flameproof lights should be used in the areas where flammable gases/vapors are present.
- Rubbish bins should be kept closed and emptied regularly.
- Good housekeeping should be maintained.
- Any leakage of flammable liquids/gases should be attended promptly.

  Care must be taken to prevent fire at construction site. All the project stores must be organized in such a way that all flammables are stored separately with proper lid in secondary containment with hazard communication labels. Gas cylinders should not be placed in the contractor shed. Gas cylinders must be placed under shade. All other construction material must be organized on racks with proper labels.

  Oily rags collection bins and other trash bins must be provided at strategic locations and cleared on regular basis. Oily rags should not be dumped on open ground, as it will contaminate soil & ground water.

  The source of ignition such as welding work, gas cutting, grinding, drilling or other must be controlled through safe operating procedures or work permits. Smoking must be prohibited in construction area. Proper measures should be taken to contain sparks from welding, gas cutting and grinding activities

- Excavation and shoring:

i) Excavation deeper than 300 mm should be done after proper task assessment and approval from project co-coordinator.

ii) Proper means of access by providing ladder should be ensured in all trenches and excavation. Ladder shall be extended from bottom of trench to at least one meter above surface of the ground.

iii) Sides of a trench that 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.

iv) Excavated material shall not be placed within 1.5m of edge of trench or half of depth of trench, whichever is more.

v) Undermining or undercutting should be avoided

vi) Safety procedures for the operation of the excavation and grading equipment (such as the safe distance from excavations) should be developed.

- Work in confined space:

i) Special precautions shall be taken against oxygen deficiency and the presence of toxic gases and flammable vapors in all types of confined work places.

ii) Proper task risk assessment should be carried out for each activity which requires work in confined space and should be approved by Site Project Co-ordinator and HSE.

iii) Signboard should be displaced at entry of the confined space– "Men Working Inside'

iv) Attendant without additional duties shall be provided for each confined space

v) Confined spaces shall include but are not limited to storage tanks, process vessels, ventilation or exhaust ducts, sewers, underground utility vaults, tunnels, manholes and pipe lines.

15.0 CONSTRUCTION HEALTH & SAFETY REGULATIONS, CODES & BEST PRACTICES

a) The Building & Other Construction workers (Regulation of employment & Conditions of Service) Act 1996 & the Building & Other Construction Workers (Regulation of employment & Conditions of Service) Karnataka Rules, 2006 (Respective states have to refer to their State Rules)

The above mentioned regulations mainly relate to Safety & Health for construction work. The following minimum safety & Health requirement to be complied with

Chapter 1: General Health & Safety Provision

- Excessive noise, vibration, etc
- Fire Protection
- Emergency Action plan
- Fencing of motors, etc
- Head & Eye protection
- Electrical hazard

- Lifting & Carrying excessive weight
- Health & Safety policy
- Dangerous and harmful environment and
- Other requirement as mentioned in chapter – I

Chapter 2: Lifting Appliances & Gears

- Construction and maintenance of lifting appliances
- Testing and examination
- Automatic safe load indicators
- Fencing of and means of access to lifting appliance and
- Other requirement as mentioned in Chapter – II

Chapter 3: Runways & Ramps
Chapter 5: Transport & Earth moving equipment

- Power shovels and excavators
- Bulldozers
- Scrapers
- Road rollers

Chapter 6: Concrete work
Chapter 7: Demolition work
Chapter 8: Excavation & Tunneling works
Chapter 9: Working on steep roof
Chapter 10: Ladders & Step ladders
Chapter 11: Catch platform and hoarding chutes, safety belts and nets
Chapter 12: Structural frame & formwork
Chapter 13: Stacking and un stacking
Chapter 14: Scaffold
Note: Contractor should also comply with other relevant requirements as mentioned in the above mentioned rules

b) Bureau of Indian Standards related to Health & Safety

Standards to be followed included but not limited to following -

- 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: 4014 (Part – I) Code of Practice for Steel Tubular Scaffolding
- 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 materials
- IS: 7205-1974 Safety code for erection of structural steel work
- IS: 7969-1975 Safety code for handling and storage of building materials
- IS: 8989-1978 Safety code for erection of concrete framed structures.

Note:

1. For all standards latest version should be taken into consideration.
2. Other relevant bureau of Indian Standard or any international standards should be complied as and when required

c) National Building Code of India 2005

Health and Safety requirement at construction site as mentioned in the National Building Code of India 2005 especially Part: 7: Constructional Practices and Safety should be complied.

Basic requirements are:

- Constructional Practices
- Storage, Stacking & Handling Practices
- Storage, Stacking & Handling of materials
- Unloading motor vehicle
- Common hazard during walling, roofing and
- Other safe practices mentioned in the National Building Code of India 2005.

d) Safety and Health in construction industry published by the International Labour Organization and amended from time to time

e) Manufacturer's instruction of safe use of equipment and machinery Code of Practice

16.0 SAFETY CHECKLISTS

Note: This is minimum indicative checklist only. Contractor should modify this checklist based on the activities being planned for implementation.

7.

Indicative construction safety checklists

a) Ladders

Sl. No.	Description	Yes	No	NA	Remarks
1	Are portable metal ladders adequate for their purpose, in good condition, and provided with secure footing?				
1	Are portable metal ladders adequate for their purpose, in good condition, and provided with secure footing?				
2	Are ladders with broken or missing rungs or split side rails, tagged and taken out of service?				
3	Are the rungs of ladders uniformly spaced?				
4	Are metal ladders inspected for damage or signs of corrosion?				
5	Are employees made aware that metal ladders are not to be used where they may contact electrical conductors or equipment				
6	Are areas around the top and bottom of the ladder kept clear?				

7	Are portable ladders used such that the horizontal distance from the top bearing to the foot of the ladder is about 1/4 of the working length of the ladder?				
8	Are ladders prohibited from being used in a horizontal position as platforms, runways, or scaffolds?				
9	Are portable ladders tied, blocked or otherwise secured against movement?				
10	Are the side rails of the ladder extending at least 36 inches above the landing?				

b) Scaffoldings

Sl. No.	Description	Yes	No	NA	Remarks
1	Is the footing of the scaffold sound, rigid, and capable of carrying 4 times the maximum intended load?				
2	Is the scaffold erected under the supervision of competent person in scaffold erection?				
3	**Is there safe access method (ladder) to the scaffold platform?**				
4	Have all uprights been provided with base plates (and, where necessary, timber sole plates) or prevented in some other way from slipping or sinking?				
5	Are all of the uprights, ledgers, braces and struts in position?				
6	Is the scaffold secured to the building or structure in enough places to prevent collapse?				
7	Are guardrails and toe boards installed on all open sides and ends of scaffold platforms?				
8	Are intermediate guardrails fitted?				
9	Are scaffolds equipped with toe boards wherever there is a possibility that falling material could cause a hazard?				
10	Are toe boards at least four inches in height?				
11	Are defective parts on scaffold immediately replaced or repaired?				
12	When employees are working on suspended scaffolds, are life lines firmly anchored to an overhead structure and not to the scaffold?				
13	Are employees wearing body harnesses attached to lifelines?				

14	Is planking of sufficient stress grade or scaffold grade timber?				
15	**Is planking of platforms overlapped not less than 6 inches or more than 12 inches or secured from movement?**				

c) Cranes

Sl. No.	Description	Yes	No	NA	Remarks
1	Is the crane on a firm level base?				
2	Are rated safe load capacities, operating speed and instructions posted and visible to the operator?				
3	Are the safe working loads and corresponding radii known and considered before any lifting begins?				
4	Is the crane machinery and other rigging equipment inspected daily prior to use to make sure that it is in good condition?				
5	If the crane has a capacity of more than 1 ton, does it have an automatic safe load indicator that is maintained and inspected weekly?				
6	Are all operators trained and competent?				
7	Has the slinger (Signaler) been trained to give signals and to attach loads correctly?				
8	Are the operator and slinger (Signaler) finding out the weight and center of gravity of the load before trying to lift it?				
9	Are cranes inspected weekly, and thoroughly examined every 12 months by a competent person?				
10	Are the results of inspections and examinations recorded?				
11	Does the crane have a current test certificate and a copy is submitted?				
12	Are accessible areas within the swing radius barricaded?				
13	Is a fire extinguisher provided on the crane?				
14	Does the crane operation comply with manufacturer's specifications?				

d) **Hoists**

Sl. No.	Description	Yes	No	NA	Remarks
1	Are workers prohibited from riding the hoist?				
2	Is overhead protection provided over the cage or platform and the operator's position?				
3	Is the safe load rating plate attached to the hoist?				
4	Has wire rope been inspected for harmful defects?				

5	Are brakes capable of stopping and holding 150 percent of the rated load?				
6	Are gears on the hoisting machine well-guarded?				
7	Are entrances to hoist way guarded or barricaded				
8	Is the Hoist operator is trained & competent?				
9	Is the hoist been inspected weekly & thoroughly once in six months by competent person?				
10	Are the results of Inspection recorded?				

e) **Hand and Power Tools**

Sl. No.	Description	Yes	No	NA	Remarks
1	Are hand tools and other equipment regularly inspected for safe condition?				
2	Are tool handles free of splits and cracks?				
3	Are handles wedged tightly in the heads of all tools?				
4	Are impact tools free of mushroomed heads?				
5	Are the heads of chisels or punches ground periodically to prevent mushrooming?				
6	Are cutting edges kept sharp so the tool will move smoothly without binding or skipping?				
7	Is sharpening, redressing or repairing tools done properly, using tools suited to each purpose?				
8	Are power saws and similar equipment provided with safety guards?				
9	Are tools used with the correct shield, guard, or attachments recommended by the manufacturer?				
10	Are abrasive wheel grinders provided with safety guards which cover the spindle ends, nut and flange projections?				
11	Are work rests and tongue guards properly set?				
12	Are portable circular saws equipped with guards above and below the base or shoe?				
13	Are saw guards checked to assure they are not wedged up thereby leaving an unguarded lower portion of the blade?				
14	Are springs checked for wear?				
15	Are guards kept in place and in working order?				
16	Are rotating or moving parts of equipment provided with 360 degree guarding?				
17	Does the operator wear eye and face protection when grinding?				
18	Is the pneumatic hose line secured to the pneumatic tool?				

19	Are tool bits secured by use of safety clips or retainers to prevent accidental disconnecting?				
20	Are appropriate ground-fault circuit interrupters provided at the job site?				
21	Are electric powered tools double-insulated or properly grounded?				
22	Are tools stored in a dry, secure location where they won't be tampered with?				
23	Are all the portable hand tools inspected at regular intervals?				

f) **Fire**

Sl. No.	Description	Yes	No	NA	Remarks
1	Is the quantity of flammable material on site kept to a minimum?				
2	Are there proper storage areas for flammable liquids and compressed gases, e.g. LPG and dissolved acetylene, oxygen?				
3	Are containers and cylinders returned to these stores at the end of the shift?				
4	If liquids are transferred from their original containers are the new containers suitable for flammable materials?				
5	Is no smoking boards displayed and banned in the areas where gases or flammable liquids are stored and used? Are other ignition sources also prohibited?				
6	Are gas cylinders and associated equipment in good condition?				
7	When gas cylinders are not in use, are the valves fully closed?				
8	Are cylinders stored securely outside under shade?				
9	Are adequate bins or skips provided for storing waste?				
10	Is flammable and combustible waste removed regularly?				
11	Are the right number and type of fire extinguishers available and accessible?				
12	Is there adequate number of trained personnel deployed at the site in all shifts?				

g) **Manual material handling**

Sl. No.	Description	Yes	No	NA	Remarks

1	Has the risk of manual handling injuries been assessed?				
2	Are hoists, wheelbarrows and other plant or equipment used so that manual lifting and handling of heavy objects is kept to a minimum?				
3	Are materials such as cement ordered in 25 kg bags?				
4	Can the handling of heavy blocks be avoided?				
5	Is the weight of the material for manual handling restricted as per norms? (Men – 50 Kg and Women – 30 Kg)				

h) **Excavations**

Sl. No.	Description	Yes	No	NA	Remarks
1	Is an adequate supply of timber, trench sheets, props or other supporting material made available before excavation work begins?				
2	Is this material strong enough to support the sides?				
3	Is a safe method used for putting in the support, i.e. one that does not rely on people working within an unsupported trench?				
4	If the sides of the excavation are sloped back or battered, is the angle of batter sufficient to prevent collapse?				
5	Is there safe access to the excavation, e.g. by a sufficiently long, secured ladder?				
6	Are there guardrails or other equivalent protection to stop people falling in?				
7	Are properly secured stop blocks provided to prevent tipping vehicles falling in?				
8	Does the excavation affect the stability of neighboring structures?				
9	Are materials, spoil or plant stored away from the edge of the excavation in order to reduce the likelihood of a collapse of the side?				
10	Is the excavation inspected by a competent person at the start of every shift; and after any accidental collapse or event likely to have affected its stability?				

i) **Roof work**

Sl. No.	Description	Yes	No	NA	Remarks
1	Are there enough hard barriers and is there other edge protection to stop people or materials falling from roofs?				

2	Do the roof battens provide safe hand and foot holds? If not, are crawling ladders or boards provided and used?				
3	During industrial roofing, are precautions taken to stop people falling from the leading edge of the roof or from fragile or partially fixed sheets which could give way?				
4	Are suitable barriers, guard rails or covers, etc provided where people pass or work near fragile material such as asbestos cement sheets and roof lights?				
5	Are crawling boards provided where work on fragile materials cannot be avoided?				
6	Are people excluded from the area below the roof work? If this is not possible, have additional precautions been taken to stop debris falling onto them?				

j) **Noise**

Sl. No.	Description	Yes	No	NA	Remarks
1	Are the locations where high noise levels (>85dBA) identified at construction site?				
2	Are engineering and administrative controls been applied to eliminate or reduce the excessive noise?				
3	Are hearing protectors and a hearing conservation programme provided for personnel working at high noise areas (>85dBA)?				
4	If engineering and administrative controls are not feasible, is personal hearing protection provided to reduce sound levels?				
5	Is the use of hearing protection equipment enforced?				
6	Is hearing protection equipment correctly fitted and maintained in a clean and sanitary condition?				
7	Is an audiometric testing programme in effect?				
8	Are employees instructed in the effects of noise on hearing, the signs of over-exposure to noise, and proper use of hearing protectors?				

k) **Protective clothing**

Sl. No.	Description	Yes	No	NA	Remarks
1	Have adequate personal protective equipment, e.g. hard hats, safety boots, gloves, goggles, full body harness and appropriate dust masks been provided?				

2	Are the PPE in good condition and worn by all who need it?				
3	Are the site personnel doing chipping, concreting, chiseling etc., wear eye protectors?				

l) **Welfare**

Sl. No.	Description	Yes	No	NA	Remarks
1	Have suitable and sufficient numbers of toilets been provided and are they kept clean?				
2	Are there clean washbasins, warm water, soap and towels?				
3	Is suitable clothing provided for those who have to work in wet, dirty or otherwise adverse conditions?				
4	Are there facilities for changing, drying and storing clothes?				
5	Is drinking water provided?				
6	Is there a site hut or other hygiene accommodation where workers can sit and have food?				
7	Is there adequate first aid boxes provision?				
8	Is the list of first aiders displayed at the construction site?				
9	Are welfare facilities easily and safely accessible to all who need to use them?				

Safety Tool box talk

1. Excavations

- Before digging, check for services, water, gas, electric, fiber optics. Are they live or dead?
- Excavations must be supported or battered back where necessary to prevent collapse.
- Use ladders to access, do not climb support structures.
- Prevent workers from falling into excavations more than 2m deep by fitting rigid barriers.
- All excavations in public places, regardless of depth should be provided with substantial barriers.
- Protect starter bar ends so as to prevent puncture injuries in excavations should persons fall in.
- Keep soil heaps back at least 1.0m from excavation edge.
- Stop blocks to be fitted when tipping into excavation to prevent vehicles from falling in.
- Wear your hard hat at all times.
- Do not jump across excavations, use a bridge or walk around.
- Never remove or alter any supports or braces.
- Do not drive vehicles or plant alongside of excavations.
- Make sure excavations do not undermine the footings of scaffolds or the foundations of nearby buildings or walls.

2. Scaffolding

- Do not remove or interfere with ties, guardrails, bracing, toe boards and ladders.
- Report scaffold defects to a supervisor.
- Use the provided ladder access or stairs.
- Do not build make-shift platforms.
- Ensure you know the loading capacity of the scaffold you are working on and do not exceed this under any circumstances.
- When stacking materials, always leave a passage way of at least two boards wide for the other people to pass.
- Ensure materials are stacked correctly and cannot fall, use brick guards or netting where required.
- Do not leave tools or materials lying about on the platform.

3. Mobile tower scaffolds

- Is the ground firm, level and capable of supporting the scaffold when fully loaded?
- Are all the component parts in good order?
- Are the wheels locked when tower is in use?
- Are the maximum height: base ratios observed
- Are all towers erected by competent persons?
- Are manufacturer's instructions available on site?
- Are working platforms fully boarded out?
- Are working platforms fitted with double guardrails/toe boards?
- Is there an internal access ladder and deck trap.
- If outriggers are fitted, are they secured?
- If tower to tower walkways are fitted, do they have guardrails and toe boards.
- Is there a system in place for checking towers before and during use?
- Never move towers with people or materials on the working platform.

4. Prevention of falls

- Any place from which a person is liable to fall from 2m or more shall be fitted with edge protection or other suitable barriers.
- If these are not practicable or for short duration work, other means such as fall arrest devices can be used.
- Choose a safe method of getting to and from the work area.
- Ensure work platforms have double guard rail and toe board or other barriers.
- Only use ladders as workplaces for short duration work and then only if it is safe to do so.
- Boatswain's chairs/seats should only be used for light, short term work where not practicable to provide a working platform.
- Use harnesses and lines to prevent falls as a last resort.

5. Slinger / Signalers

a) Slinger:

- Wear helmet, safety footwear, gloves and High Visibility vest.
- Only use tested and correctly marked lifting gear.
- Ensure all parts of the load are secure, and crane hook positioned centrally over the load.

- Use packing, if necessary to prevent damage to equipment.
- Do not shorten chains by tying knots in them.

b) Signaler:

- Stand where the load and driver are clearly visible during the complete lift.
- Ensure no-one is in the path of the load.
- Never let the crane encroach near to overhead lines.
- Use clear and distinct signals.
- Be clearly identifiable to the driver.

6. Confined spaces

- Do not enter a confined space until a full assessment is made by a competent person.
- If breathing apparatus is required, do not enter confined space until you are trained to use it.
- Obey permits at all times.
- If you suffer from any medical conditions that may affect your safety, you must not enter a confined space.
- Check communications and monitoring equipment.
- If a confined space is classed as hazardous, there must be an 'observer' on the outside who knows what to do in an emergency.
- Wear protective equipment provided.
- Ensure recovery apparatus is working.
- Do not attempt a rescue without first raising the alarm and wearing breathing apparatus.
- No naked flames in vicinity of confined space.
- Observe good hygiene in confined spaces.

7. Portable electric tools

- Check that the supply and the tool both are 220 V with the appropriate plug and socket.
- Before using a portable electric tool check to see it is properly earthed, unless it is an approved type that does not require earthing.
- Before using an electric tool, make sure that the casing is undamaged. If it is damaged, do not use the tool.
- Make sure that all cables, plugs or connectors are sound and properly wired up.
- Ensure that switches are working smoothly and freely before connecting to the supply.
- Make sure that the power cable is long enough to reach your working place without straining it.
- Keep power cables off the floor. They may get damaged or cause a trip hazard.
- Never stand on a damp or wet surface when using electrical equipment, and keep equipment clean and dry.
- Portable electric tools should only be used for their designed purpose.
- Never connect a portable electric tool to a lighting socket.
- Never use worn, blunt or damaged bits or other accessories.
- Disconnect tools when not in use.
- Electrical power tools should be regularly inspected and maintained by a competent electrician.

- Wear eye protection even when drilling downwards.
- Report all defects immediately

8. Electric arc welding

- Make sure that your shield, helmet or goggles contain the correct glasses.
- Wear adequate protective clothing including leather gauntlet gloves and clear goggles for chipping.
- When necessary, use screens to protect neighbouring workers and passers-by from the arc.
- Ensure that cables and connections are in good condition and firmly attached.
- Make certain that the welding equipment, bench or work piece is properly earthed.
- Check that the electrode holder is fully insulated and always place it in an unearthed surface when not in use.
- Stand on an insulated mat when the ground is damp.
- Arrange good ventilation in the welding area, but do not use oxygen to ventilate confined spaces.
- Avoid welding near flammable materials.
- Never weld enclosed vessels, drums or tanks which have contained flammable materials unless they have been purged by steaming or boiling, or filled with inert gas, and tested and certified safe to work on.
- Do not weld inside enclosed vessels unless precautions have been taken for your safety.
- Keep trailing welding cables clear of roads and walkways. Secure to overhead fixtures where possible.
- BEWARE OF ARC EYE – PROTECT YOUR EYES

9. Temporary Road Works

- Before Road Works start you must be qualified to work on road and street works.
- Before commencing any road works which may cause obstruction to public, police should be informed.
- Signs must be placed so they can be easily seen by road users and give adequate warning of road works ahead.
- Diversion signs must give adequate warning.
- All vehicles must display appropriate notice at rear of vehicle during Road Works
- As work progresses, signs should be moved forward.
- Adequate illumination should be provided for signs and they should indicate extent or work.
- Regular checks should be made to ensure that signs and warning lights are in position and working.
- Temporary traffic signals must have red, amber and green lights and a time mechanism to suit traffic low.
- You must obey the instructions of your supervisor.

❖ **Hazards on Road Works and Motorways**

- Safety barriers must protect public and workers.
- Wear high-visibility clothing and safety helmets, always.
- You must be alert at all times and keep a sharp look out.

- All vehicles to be fitted with amber flashing lights on top and switched ON when entering or leaving works area.
- Only enter and leave site at the authorised points - don't enter or leave site by any other route.
- Don't move cones or signs unless necessary for operational reasons. Always replace in original position.
- Buffer lanes must be kept clear at all times.
- Observe speed limits.
- Caution when leaving site if merging with motorway traffic
- Lorry drivers - don't reverse without the aid of a signaler.

10. Ladders

- Use clear varnish to protect a ladder; paint may cover a defect
- Never use an unsound ladder.
- Be sure the ladder is set on a firm level base.
- Ladders longer than 3m in length should be secured or footed when this is not practical.
- Make certain the ladder reaches a sufficient height above landing platform, unless an alternative hand hold is provided.
- The correct pitch of a ladder is 1 ft (300mm) out at the base for every 4 ft vertical height.
- Use the right length ladder for the job. Never lash two short ladders to make a longer one.
- Do not carry loads on ladders - use a hoist line.
- Do not lean sideways from a ladder - it is safer to move the ladder.
- Face the ladder when climbing or descending.
- Beware of wet, greasy or icy rungs.
- Inspect ladders before use and regularly when stored.
- Work should only be carried out from a ladder when the job is of short duration and can be carried out safely.

11. Cartridge tools

- Only use Cartridge Tools if you have been trained and authorised in writing to do so.
- Read makers' instructions carefully before using gun.
- Before handling gun make sure it is not loaded.
- Load gun with barrel pointing in safe position - away from you.
- Never place your hand over the end of the barrel.
- Never walk around with a loaded gun. Always load at area of use.
- Check material into which bolt is to be fired to ensure the safety of persons on the other side.
- Allow at least 3 inches (76mm) from edges of concrete or brickwork.
- Hold the gun at right angles to the job when firing.
- Wear goggles and ear defenders.
- In the event of a misfire, wait a minute before unloading.
- Never leave gun loaded when not in use.
- Always clean up used cartridges and look out for any misfires. Dispose of these safely.
- Always treat cartridge tools with respect

12. Hand tools

- Always use the correct tool for the job.
- See that every file has a handle.
- Chisels and punches should be ground to prevent mushrooming.
- Keep hammer heads tightly wedged on their shafts.
- Renew wooden handles that are split.
- Keep the edges of cutting tools sharp.
- Hands behind the cutting edges when working.
- Do not use screwdrivers on work held in the hand.
- Keep tools in boxes or racks when not in use.
- Protect sharp edges of tools that are to be stored or carried.
- Scrap tools that are worn or damaged beyond repair.
- Use the right size of spanner to fit the nut.
- Good tools mean faster and safer working

13. Abrasive wheels

- The speed of the machine must not exceed the maximum permissible speed of the wheel.
- Don't exert heavy pressure on the wheel.
- Never use the side of the wheel.
- Keep your fingers away from the cutting edge of the wheel.
- Ear and eye protection must always be worn.

❖ **Using Portable Abrasive Wheels:-**

- Don't mount an abrasive wheel unless authorised in writing and trained to do so.
- Only reinforced discs to be used on hand-held machines.
- Check that the maximum wheel speed is greater than the maximum spindle speed before fitting.
- Adjust the guard to expose the minimum wheel surface necessary for the operation.
- Be aware of other workers in your area, don't put them at risk by your actions.

❖ **Using Bench-Mounted Abrasive Wheels**

- Adjust the tool rest as close as possible to face of wheel
- Keep the glass screen in the safety position.
- Keep your fingers below the tool rest level.
- Use the correct grade of wheel for the work in hand.
- Keep the face of the wheel evenly dressed.
- Run a replacement wheel for a full minute after fitting before attempting to use it. Stand clear during the test.
- Stop the wheel when not in use.

14. Electrical services

❖ **Underground Cables**

- Before digging, check plans and use cable locating devices.
- Assume all cables are live, unless your supervisor tells you they are dead.
- Hand dig trial holes to expose cables.

- When exposed, protect cable from damage and support it.
- Put warning tape on exposed live cables.
- If cable is accidentally damaged, keep all persons clear until local Electricity Company has inspected it.

❖ **Overhead Power Lines**

- Treat all overhead lines as live. Do not assume that they are only telephone wires.
- Ensure you know the maximum clearance distances specified by the Electricity Company, and any other special precautions.
- Do not bypass goal posts, barriers or other warnings.
- Check your route is clear of overhead power lines prior to moving any materials likely to come into contact with lines.

15. Gas Welding/Cutting

- Are you aware of the requirements of permit system?
- Oil or grease must not contact oxygen fittings.
- Use goggles, face shields or helmet with dark lenses.
- Open cylinder valve slowly. Close valve when not in use.
- Before commencing welding, ensure all rubbish is removed.
- When welding near flammable materials, beware of flying sparks and hot slag. Keep fire extinguishing equipment available and check area before leaving.
- Do not attempt to weld in enclosed vessels or tanks until safety precautions have been taken.
- Do not use gas cylinders as work supports.
- Do not leave torch in enclosed vessels when not in use.
- Do not weld material degreased with solvents unless it is absolutely dry.
- Do not allow any source of heat to reach cylinders.
- Do not weld galvanized or coated metals without taking proper precautions against fumes.
- Use screens to protect other personnel.
- Keep hose lines clear of traffic lanes.
- Use in conjunction with compressed gas cylinders

16. Compressed gas cylinders

- Treat every cylinder as ‘full’ and handle carefully.
- Always use a carrier and secure the cylinder into it.
- Always secure acetylene cylinders in an upright position, both in use and in storage.
- Store all cylinders so that they cannot fall or roll.
- Keep them away from sun, artificial heat, flammable materials, corrosive chemicals and fumes.
- Avoid damage to valves and fittings. Do not use them for lifting or carrying.
- Keep valves and fittings of oxygen cylinders free from oil and grease.
- Do not use cylinders as rollers for moving equipment.
- Open cylinder valves slowly, and close sufficiently to shut off gas - never use force.
- Always lift cylinders from trucks - do not drop or slide them.
- Keep hose lines clear of traffic lanes.

- In case of fire, call fire brigade first then cool cylinders with water spray if safe to do so.
- Always operate within the control or permit system applicable.
- Do not use L.P.G. or oxygen cylinders without flashback arrestors.
- Report any damage or defects immediately

17. Manual material handling

- Where possible, gloves should be worn to protect against cuts, scratches or punctures.
- Wear safety boots or shoes to protect toes from falling loads
- Ensure you know the approximate weight of the load before lifting.
- Do not attempt to lift alone any load that is too heavy, too large or awkward.
- See that there are no obstructions in the direction you will be going.
- Take up position, feet hip width apart, one foot slightly advanced pointing in direction it is intended to move, Bend the knees; back muscles should be relaxed, Get a secure grip of the load, Lift, keeping the back straight, arms close to body, leg muscles taking the strain, Step off in direction advanced foot is pointing, load held close to body.
- Do not carry a load which obscures the vision.
- When lifting to a height from the floor do it in two stages.
- Avoid twisting the trunk whilst lifting or carrying a load.

18. Fire

- Make sure you know the contents of the Fire Plan and what to do in the case of fire.
- Make sure you know your escape route.
- Keep fire doors and passageways clear and unobstructed.
- Know where the nearest fire point is and do not obstruct access to fire extinguishers.
- Learn the operation and limitations of the fire extinguishers in your area.
- Do not hang clothing over, or near, heaters. Do not let paper, oily rags or other rubbish accumulate.
- Only smoke in areas where this is allowed.
- Use proper containers for flammable liquids. Do not use open tins or buckets.
- Handle flammable liquids at a safe distance from possible sources of ignition.
- Check before and after using blowlamps, welding and cutting equipment.
- Bitumen boilers, soldering irons and gas rings must be on non-combustible stands.
- Switch off from the mains any electrical equipment when not in use.
- Plan in advance - you won't have time when fire breaks out

19. Noise

- Wear ear protectors if the noise is such that you have to shout to someone one metre away to be heard.
- Do not enter noise protection zone without the required PPE.
- Keep machine covers closed when operating.
- Don't keep machinery running unnecessarily.
- If possible, shield noisy processes.
- Make sure that ear plugs are a good fit in each ear and are correctly inserted.
- Use disposable ear plugs once only.
- Hands should be clean when handling all types of ear plugs.
- Ear muffs should be a good fit to the head all-round the seal.

- See that muff seals are always in a serviceable condition.
- Do not alter the pressure of ear muffs by bending the head band.
- Report damaged ear protection and replace.
- There is no satisfactory treatment for noise induced hearing loss.

20. Eye protection

- A tiny fragment in your eye can cause disaster.
- Do not watch welding processes unless your eyes are properly protected.
- Do not go into areas where eye protection is required unless you are wearing protective equipment.
- Take care of any protective equipment issued to you.
- Have any damaged, lost or unserviceable protective equipment replaced immediately.
- Make sure your eye protectors are suitable for you and for the work being done.
- The place for eye protectors is over your eyes - not on your head or round your neck.
- Remember - Eye protectors are replaceable; but Not your eyes.

21. Lifting gear

- Check SWL on equipment prior to use.
- Know the weight of the load before lifting.
- Ensure a current test certificate is available for the equipment in use (6 months).
- Ensure there is no damage to the equipment.
- Reject any that are damaged.
- Return lifting equipment to the store after use.

❖ **Slings:-**

- Do not use fibre or wire rope slings for hot loads and keep them away from welding or burning.
- Protect slings from sharp edges
- Ensure there are no broken ends in wires or chafing on fibre slings.
- Lower load onto suitable battens to prevent damage to slings.

❖ **Chains:-**

- Ensure chain is not kinked or twisted.
- Do not shorten a chain by knotting it.
- Never lengthen a chain by joining pieces together.
- Do not lubricate chains. Oil can pick up abrasive materials such as sand and grit.
- Do not expose chains to acids or corrosive substances.

❖ **Shackles, Hooks and Eye bolts:-**

- Use the correct type for the job.
- Ensure pin is free, but not loose, in tapped hole.
- When using a shackle with nut and & bolt the bolt should be free to rotate when nut is tight.
- Swivel hooks should rotate freely.
- Hooks without a safety latch, must be used.

22. Trainees & young persons

- Dress tidily and safely
- Close fitting overalls, tie tucked in, short or rolled-up sleeves, safety boots or shoes.
- Pay attention to your instructors. They will teach you the safe way to work.
- Do not remove guards from machines. They are provided for your protection.
- Always operate your machine as instructed. If you have never used a machine, leave it alone. Do not operate any plant or equipment until you have been properly trained and authorised in writing to do so.
- Do not handle any substances for which you have had no instruction about its use and possible hazards.
- Wear all specified personal protective equipment which is provided for your use.
- If you have to use compressed air, don't direct it at yourself or your workmates. It can be a painful Killer.
- Short cuts often lead to shorter lives. Use the recognised routes.
- Horseplay is fool's play. Behave sensibly while on the job site.

23. Dumpers

- Only operate dumpers if you are 18 years of age or over, have a full driving license and you have been trained and authorized in writing.
- At the start of each shift always check: Brakes, Steering, Oil, Water, Tyres and Warning Beacons.
- Never allow passengers to ride on the vehicle.
- Always drive the machine with consideration for other employees. Do not drive at excessive speed.
- While being loaded, engage handbrake and disengage gears. Do not remain in the seat.
- Stand well clear.
- Ensure all loads are secure and that forward vision is not impeded.
- Always steer dumpers with caution.
- Avoid harsh acceleration and braking.
- If necessary reverse down gradients to prevent tipping.
- Do not travel across steep banks or gradients.
- Before tipping make sure that no person or obstruction is in the way.
- When tipping into excavations use chocks or stop blocks.
- Report all defects immediately.
- At the end of the shift, park on level ground, with the hand brake applied and keys removed to a safe place.

24. Chemical management.

- All chemicals assessment must be carried out for substances covered by a hazard warning sheet, label or those other substances known to cause health risks, such as welding fume, brick dust etc.
- Ensure you know the requirements of the assessment and are trained to use the substance.
- **Hazardous substances enter the body through:**
    - Ingestion - eating food with contaminated hands

- Inhalation - breathing in harmful dusts or fumes
- Absorption -chemicals entering through cuts etc

- Known examples of hazardous substances are:
  - contaminated ground
  - all forms of dust
  - epoxy based products
  - Concrete
  - Solvents
  - oils and lubricants
  - cement and mortar
  - welding fume
- Use any personal protective equipment required by the assessment.
- Do not eat, drink or smoke when handling substances.
- Know where the washing and first aid facilities are.
- Always wash at the end of a shift or before eating.
- Ensure hazardous substances are locked away

25. Compressed air

- Do not use compressed air for any other purpose other than that for which it is intended.
- Never aim compressed air directly at yourself to blow dust off clothes or hair.
- Do not clean down machines and benches with compressed air. Use a brush or special vacuum cleaner.
- Horseplay with compressed air is forbidden. This can cause agonizing injury or death.
- Make sure that your compressed air tool, hose and fittings are working properly. If not, report the fault to your supervisor.
- Before changing tools, make sure that the supply line is closed or has an automatic shut-off valve.
- Always close a hose by the valve. Never kink the hose.
- Do not leave hoses lying around for others to trip over.
- Always ensure that connectors are fully “home” and safely latched.
- Do not misuse compressed air

26. Slips, trips and falls

- Over a third or 33% of all accidents are caused by slips trips or falls. If there are trip hazards DO NOT ignore them. Remove or report them.
- Keep your work area tidy. Accidents are always caused by people tripping over their own tools, equipment or materials.
- Ensure that working platforms are kept clear.
- Scaffold walkways must allow free passage.
- Do not leave uncovered holes or openings. In particular raised floors present a problem when panels are left out.
- Do not trail cables or festoons across walkways.
- Walkways and passages must be kept clear and not be used for stacking or storage of materials.
- Ensure your shoes or boots are free from mud or other substances which would cause you to slip, especially when climbing ladders.

- Always look for the most level route when crossing site. Steep inclines or batters do not afford a safe passage.
- Clear up any spills immediately.
- Do not carry loads single handedly that are too heavy or obstruct your view, get help.

27. Environmental

a) Air pollution

- Comply with the speed limits on site and keep to the designated haul roads.
- Water may be used to damp down haul roads, but ensure this does not cause pollution of water courses. Do not use water without permission if a hose pipe ban is in force.Use dust extraction, or collection equipment, on machines fitted with this equipment.
- If you do not have dust extraction, you may need to use water to damp down.
- If you are a driver of transport used to move dusty materials, ensure load is sheeted or does not create dust blow.
- Never burn materials, unless you have Site Management permission.
- Shut down or turn off plant and vehicles when not in use.
- Report any defects to plant exhaust systems immediately to your supervisor.

b) Noise:-

- We are allowed to work during specified hours, (you will have been told at the induction). Do not attempt to work outside these hours without permission.
- Turn off all vehicles and plant when not in use.
- If you feel an item of plant or a vehicle is more noisy than usual, report it.
- If you need to use noise screens to prevent noise escaping, please do so.
- If you receive a complaint from a member of the public, be diplomatic and take them to see Site arrangement.
- If you are approached by an Environmental Health Officer, be co-operative and take them to see Site Management.

c) Water pollution

- Never discharge any water or substance from site into a water course or onto land without first obtaining permission from Site Management.
- If settling tanks/ponds or soakaways become ineffective, tell you supervisor.
- Report, at once, any item of plant or machinery that starts to leak oil or fuel or if drip trays become full or ineffective.
- Do not attempt to re-fuel any item of plant or machinery away from the designated re-fuelling points.
- Any empty drums, having contained fuels or chemicals, must be returned to the “empty drum” storage area.
- If there is an oil/fuel/chemical spillage, report this to Site Management at once.
- If you are approached by anyone from the Environment Agency, be courteous and direct them to Site Management.

d) Waste

- Always place waste in the correct skip.
- If you are unsure which the correct skip to use is, ask your Foreman.
- Never overfill a skip.

- Keep the area around a skip tidy.
- Waste can either be controlled or special waste:-
    - controlled waste is any kind of household and most kinds of construction waste
    - special waste is usually that which is dangerous to life; eg asbestos, acids, chemicals, etc.,
- Never mix controlled and special waste in the same skip.
- If there are skips for recyclable materials, only place the correct materials in that skip.
- Personal or canteen waste must be placed in the bins provided.
- Always store materials that you use safely so that they will not be damaged.

e) Energy conservation

- The unnecessary use of energy is a waste of money and impacts on the Environment through the production of pollutants and by wasting resources.
- Ensure all electrical equipment is switched off at the end of the shift or, if timers are incorporated, they are set correctly.
- Don't block heaters or ventilators.
- Don't allow taps to run, wasting water. Report any leaking taps or pipes.
- Switch off all plant, tools or vehicles when not in use.
- Ensure all plant is well maintained.
- Switch off site and office lighting when not needed.
- Be aware that some lighting is used for safety and security. If unsure, ask.
- Report any defects in plant or equipment at once.

17.0 DRAFT SAFE OPERATING PROCEDURES (SOPS) TO BE SUBMITTED BY INDIVIDUAL CONTRACTOR

Safe Operating Procedure (SOP) For Working at Height

1. ACTIVITY DESCRIPTION

This includes all works carried at a height greater than four (4) feet above and where there is a risk of falling.

It includes qualifications of climbers, maintenance of equipment, training and prevention of accidents involving employees and members of the public.

2. POTENTIAL HAZARDS PRESENT

Fall from height & falling objects

3. LOCATION:

The entire locality where work has to be performed at 6 feet above the ground level inside the campus.

4. PRE-ACTIVITY MEETINGS

The contractors and or the Site representative designated to supervise the job will inform the HSE leader/ Facility leaders before starting the work. They will inform about the High Risk Operations. The person (HSE/Facility) designated to supervise the job, will have the overall responsibility of all the safety measures being implemented.

The following points will be discussed in the Pre-activity meeting:-

- Hazard recognition & preventive measures
- Training Requirements

- Review special provisions /requirements
- Emergency rescue procedures
- Scheduling & sequence
- Plan for executing the work

5. SAFE WORKING PROCEDURE: -

We will ensure that the following check points will be followed where the activity will be carried out:

- The surrounding area is checked & employees are informed & shifted to a safer work place, if found necessary.
- The surrounding area is barricaded & caution signage is displayed
- The ladder/scaffold provided and tied at the top, is proper.
- The safety belt & lifeline anchor is used
- A standby person is deputed to watch & warn the person who is coming near the place where the activity is performed.
- The working platform is provided & supported with structure.
- Personal Protective Equipment is used (Hand gloves, apron, helmet, safety glasses, safety shoes, safety belt, respirator etc).
- Those who work at a height more than 6 feet has undergone work at height training & training records will be maintained and that is issued to HSE before starting the activity.
- The electrical equipment is having earthing, three-pin plug & cable is in good condition.

6. EMERGENCY PROCEDURE: -

We have learnt that there are two types of emergencies, one is external emergency like thunder, storm, strong wind, rain etc and the other is the internal emergency like our worker getting physical or psychological stress.

In case of any external emergencies like thunderstorm, strong wind, rain etc, the following steps will be taken:

- Climb down the place of work and inform the process owner.
- In case of any internal emergencies like physical or psychological stress to the our employee,
- We will call the standby person for help.
- If possible, the workers will climb down the place of work and inform the process owner or else wait for the help to arrive
- Standby person will contact the Emergency Telephone number

7. WORK PERMITS: -

We will take Work at Height Permit signed by the HSE / Facility Personnel after a thorough review of the contractors' safety measures and equipment on site.

8. NECESSARY PERSONAL PROTECTIVE EQUIPMENT:

Based on Hazard Assessment, suitable Personal Protective Equipment (PPE) viz., Hand gloves, apron, hard hat, safety glasses, safety shoes, safety belt, respirator mask etc. will be used.

9. SPECIALISED TRAINING REQUIREMENT

The workers are trained in the process as well as the High risks involved. They are trained on the High-risk activity procedures.

10. PERIODIC VERIFICATION OF PROCEDURES: -

The work instructions and safety procedures are reviewed as required or annually.

Signature of Contractor

Date:

Safe Operating Procedure (SOP) for Hot Work

1. ACTIVITY DESCRIPTION:

The purpose of this SOP of Hot Work activities is to establish written procedures to prevent fires and injuries resulting from any temporary operation involving open flames or producing heat and/or spark. The programme includes but not limited to following:

a) Welding/Hot Works Procedures: Any activity that results in sparks, fire, molten slag, or hot material that has the potential to cause fires or explosions.
b) List of Jobs involving Sparks/Flames

The type of work mentioned here below, may provide 'Source of ignition' to cause fire or Explosion:

a) Welding
b) Gas cutting
c) Grinding
d) Drilling
e) Chipping
f) Heating with blow lamps
g) Hacksaw cutting
h) Stress relieving using heating element
i) Soldering/ Brazing

2. LOCATION OF WORK ACTIVITY:

Location wherever Hot Work activity is carried out inside the campus.

3. POTENTIAL HAZARDS PRESENT

a) Sparks
b) Electric shocks leading to fire / accidents
c) Flying Particles
d) Flash fire
e) Explosion
f) Gaseous exposure-toxic effect
g) Contact with hot objects/material

h) Welders eye exposure to UV & IR rays
i) Splashing of toxic /corrosive chemicals
j) Danger of asphyxiation

Considering above hazards, we will be using the following safety appliances while carrying out hot work. However use of more than one safety appliances depends on the nature of the job & requirements of the job.

a) Face shield and welding shield for welders or goggles for helpers
b) Safety helmet
c) Chrome leather hand gloves/Canvas cum leather hand gloves
d) Safety harness
e) Safety shoes
f) Nomex suit
g) Welding blanket

4. PRE-ACTIVITY MEETINGS/COORDINATION

Our Site supervisor will do pre-activity meeting with Site supervisor and he will also ensure toolbox meeting with all workforce engaged for the Hot Work activities. During the meeting we make sure that job specific hazards and precautions will be communicated to workforce and preventive measure in hierarchy of controls – engineering, administrative and PPE will be implemented.

In the pre-activity meeting we will discuss:-

- Hazard recognition & Preventive measures
- Specific Responsibilities
- Training Requirements
- Identify all equipment needed
- Work details & schedule
- Emergency procedure

5. SPECIFIC RESPONSIBILITIES: -

Hot Work activities Supervisor:-

The Hot Work activities Supervisor is responsible for the safe operations of hot work activity under his supervision. These duties include:

- Establishes permissible areas for hot work./ barricade the area/ display the board
- Ensures that only approved apparatus, such as torches, manifolds, regulators and pressure reducing valves, are used.
- Ensures that all individuals involved in the hot work operations are familiar with Hot Work requirements.
- Ensures that all individuals involved in the hot work operations are trained in the safe operation of their equipment and the safe use of the process. These individuals will have an awareness of the risks involved and understands the emergency procedures in the event of a fire.
- Determines site-specific flammable materials, hazardous processes, or other potential fire hazards present or likely to be present in the work location.
- Ensures combustibles are protected from ignition by the following means:

  - Moves the work to a location free from combustibles.
  - If the work cannot be moved, ensures the combustibles are moved to a safe distance or have the combustibles properly shielded against ignition.
  - Ensures hot work is scheduled such that operations that could expose flammables or combustibles to ignition do not occur during hot work operations.
  - If any of these conditions cannot be met, then hot work will not be performed.
- Determines that fire protection and extinguishing equipment are properly located and readily available.
- Ensures sufficient local exhaust ventilation is provided to prevent accumulation of any smoke and fume.
- Ensures that a fire watch is posted at the site when:
  - Hot work is performed in a location where other than a minor fire might develop, or where the following conditions exist.
  - Combustible materials in building or contents are closer than 35 ft to the point of hot work.
  - Combustible materials are more than 35 ft away but are easily ignited by sparks.
  - Wall or floor openings are within 35 feet and expose combustible materials in adjacent areas. This includes combustible materials concealed in walls or floors.
  - Combustible materials are adjacent to the opposite side of partitions, walls, ceilings, or roofs and are likely to be ignited.

Where a fire watch is not required, the Hot Work supervisor will make a final inspection 1/2 hour after the completion of hot work operations to detect and extinguish possible smoldering fires.

Hot Work Operator

The hot work operator will handle the equipment safely and perform work so as not to endanger lives and property. Specific duties include:-

  - No hot work will be conducted without specific written authorization from the Hot work supervisor via completion of the Hot Work Permit.
  - The operator will cease hot work operations if unsafe conditions develop.
  - The operator will notify the Hot Work Supervisor for reassessment of the situation in the event of suspected unsafe conditions or concerns expressed by affected persons.

Fire Watch:

The fire watch is an individual posted in specific circumstances, as described above. The function of the fire watch is to observe the hot work and monitor conditions to ensure that a fire or explosion does not occur as a result of the work performed. The fire watch is authorized to stop any unsafe operation or activity. Specific duties and responsibilities include:

- Watch for fires, smoldering material or other signs of combustion.
- Be aware of the inherent hazards of the work site and of the Hot Work.
- Ensure that safe conditions are maintained during Hot Work operations and stop the Hot Work operations if unsafe conditions develop.

- Have fire-extinguishing equipment readily available and be trained in its use.
- Extinguish fires when the fires are obviously within the capacity of the equipment available. If the fire is beyond the capacity of the equipment, sound the alarm immediately.
- Our employees will be familiar with the facilities and procedures for sounding an alarm in the event of a fire.
- A fire watch will be maintained for at least 1/2 hour after completion of Hot Work operations in order to detect and extinguish smoldering fires.

6. SAFE WORKING PROCEDURE: -

It will be ensured that the following check points being followed where the activity is being done:

- The equipment drained, gas freed, flushed & blinded/isolated.
- The equipment isolated & LOTO applied.
- The surrounding area checked & flammable materials removed (at least 35ft away).
- Safe means of approach to the work place be provided. If ladder is used its upper end will be tied to a fixed support to prevent slipping.
- Suitable scaffolding will be provided if required of not less than 1 sq. m depending on the nature of the job. If railing & toe board are not provided safety belt is a must while working thereon.
- The drain, pit, sewer & floor opening covered/protected to prevent spark entering in.
- The control of welding spark provided using wet gunny bags/welding curtain.
- The proper lighting & proper means of exit available/provided.
- The welding return connected with the job.
- The welding cables in good condition.
- The required Personal Protective Equipment (Welding Shield, Leather hand gloves, Safety shoes, Safety glasses) arranged & is used.
- The ventilation is adequate to allow welding fumes extracted/diluted.
- The welding set energized through the earth leakage circuit breaker & earthed.
- Separate earthing drawn and fixed to the welding job at the nearest place.
- Sparks not be stroked on existing pipelines.
- All necessary safety appliances will be used while working.
- The grinder guard in position.
- The electrical power tools having earthing & three pin plug tops.
- The fire watch provided & is trained in use of fire extinguisher.
- The gas cylinder mounted on trolley & secured.
- The gas hose pipe in good condition, tested & per IS color code.
- The gas-cutting torch provided with flash back arresters.
- The proper scaffold/ladder provided & tied at top.
- The safety belt used & lifeline anchored above the work level
- The appropriate fire extinguishers provided like water type, foam type, CO_2, DCP, etc.,
- The available sprinklers, hose stream, extinguishers in service/operable.
- The workers doing hot work trained & training records given to HSE.

- The location of the nearest phone, safety shower/eye wash, fire extinguisher reviewed.
- The flammable vapor checked using explosive meter.
- Fire watch required for 30min after completion of job.
- When more than one agency is working at a place, the concerned agencies should coordinate among themselves for safety of the person working there.
- Any change of intention during tenure of the job brought into the notice of permit issuing authority before effecting the change.
- Working place cleaned after completion of the work.

7. EMERGENCY PROCEDURE: -

Two types of Emergencies may happen. One is emergency that may happen in the surrounding area & other is internal emergency like fire on the equipment due to short circuit or Electric shock & injury to the person performing the activity.

During External emergencies,

- ❖ Safely shutdown the Equipment
- ❖ Safely evacuate to the safe assembly area

In case of any emergency like fire on the Equipment:

- ❖ Switch off the equipment main power supply.
- ❖ If trained use the fire extinguisher to extinguish the fire
- ❖ Contact the Emergency Phone
- ❖ In case the fire is uncontrollable, break the MCP to alarm for communication of the Emergency requiring safe evacuation
- ❖ The Site manager and HSE Leader informed at the earliest possible.

In case of any emergency like Electric shock & injury to the person performing the activity:

- ❖ Safely shutdown the Equipment
- ❖ Isolate the Employee from the Work area
- ❖ Contact the Emergency Telephone number

8. WORK PERMITS: -

We make sure that no work will start without obtaining Hot Work permit from Site representative. Our site supervisor will ensure that all permit conditions are compiled throughout the activity. We make sure that hot work will only be started after due approval of Site HSE or Facility engineer.

9. NECESSARY PERSONAL PROTECTIVE AND OTHER EQUIPMENT:

Following PPE's will be used as required while performing the Hot work activity:-

- Welding Shield,
- Leather hand gloves,
- Safety shoes,
- Safety glasses.
- Welding mask
- Ear plug

In addition to this following safety equipment are included: warning signs, barricades, traffic management signs; fire blankets, fire extinguisher.

10. SPECIALISED TRAINING REQUIRED: -

The workers are trained in the process as well as the High risks involved. They are trained on the High-risk activity procedures. All persons engaged for the hot work have undergone hazard specific training and basic fire extinguisher operation training. Welder and gas cutter have undergone job specific training like welding safety, gas cutting safety, grinding safety training, etc.

Signature of Contractor
Date:

Safe Operating Procedure (SOP) for Excavation Work

1. ACTIVITY DESCRIPTION

Earthwork of more than one meter is considered as Excavation.

2. POTENTIAL HAZARDS PRESENT

a) Soil Collapse/Land sliding
b) Fall from Height
c) Electrical Shock due to contact of live underground cable, if any
d) Damage/puncture of the underground pipelines, if any

3. LOCATION:

Wherever earth is digged beyond 1 metre, inside the campus

4. PRE-ACTIVITY MEETINGS: -

The contractors and or the Site representative designated to supervise the job will inform the HSE leader/ Facility leaders before starting the work. They will inform about the High Risk Operations. The person (HSE/Facility) designated to supervise the job, will have the overall responsibility of all the safety measures being implemented.

The following points will be discussed in the Pre-activity meeting:-

- Hazard recognition & Preventive Measures
- Training Requirements
- Work plan & scheduling
- Equipment required
- Emergency procedure

5. WORKPERMITS: -

Excavation Work Permit signed by HSE / Facility Personnel will be taken after a thorough review of our safety measures and equipment on site.

6. SAFE WORKING PROCEDURE: -

Following check points are ensured where the activity is being done:

- The utilities in the area like gas pipeline, electrical cables, sewer, data cables identified
- The concerned electrical or other service lines isolated & LOTO applied
- The shoring or trenching shield required & provided to prevent soil shift.
- Check for any overhead obstruction.
- Proper ventilation & lighting available/provided.
- The area barricaded & caution board displayed.
- Avoid the personnel approach to the edge of the excavating pit.
- The electrical equipment earthed & cable protected from damage.
- The proper scaffold/ladder provided & tied at the top.
- The standby person deputed to provide help in emergency.
- The safety belt used & lifeline anchored above the working level.
- The required Personal Protective Equipment (Hand gloves, Helmet, Safety glasses, Ear plugs, Safety Shoes).
- The employees working in excavation are trained & training records given to HSE

7. EMERGENCY PROCEDURE: -

In case of any external emergency in surrounding areas,

a) Shutdown the operation safely
b) Move towards the safe assembly point.

In case of any internal emergency like injury to personnel working due to landslide, electric shock etc.:-

a) Standby person to help the victim to come out of the pit
b) If not possible, call Emergency Telephone number
c) The process owner and HSE staff be informed at the earliest possible.

8. NECESSARY PERSONAL PROTECTIVE EQUIPMENT:

Rubber hand gloves, Helmet, Safety glasses, Safety shoes, Earplugs.

9. SPECIALISED TRAINING REQUIREMENT: -

The operators are trained in the process as well as in the High risks involved.

10. PERIODIC VERIFICATION OF PREOCEDURE: -

Work instructions and safety procedures are reviewed annually

Signature of Contractor
Date:

Standard Operating Procedure (SOP) for Confined Space

1. DESCRIPTION

Confined space - a space or work area not designed or intended for normal human occupancy, having limited means of egress and poor natural ventilation, and/or any structure, including buildings which have limited means of egress.

BIT

This SOP is provided to assist our worker entering a confined space where hazards are associated with. However, this is only a guideline with information pertaining to entering a confined space.

2. POTENTIAL HAZARDS

Drowning, shortage of oxygen and presence of harmful gases can cause fatality or severe injury.

3. LOCATION:

Confined spaces identified at entire campus

4. PRE-ACTIVITY MEETINGS/CO-ORDINATION: -

The contractors and/or the Site representative designated to supervise the job will inform the Site HSE officer. The person (HSE/Facility) designated to supervise the job, will have the overall responsibility of all the safety measures being implemented

5. WORK PERMITS: -

We the contractors will take a Confined Space Work Permit signed by the HSE / Facility Personal after reviewing the site conditions, safety measures taken and contractor equipment on site.

6. SAFE WORKING PROCEDURE: -

We will ensure that the following check points are followed as applicable where the activity is being done:

- The confined space drained, gas freed, flushed & all incoming & outgoing lines render safe by all suitable means
- The confined space left open for fresh air circulation before entry (Min 2 hrs before entry after opening the confined space)
- The surrounding area checked & barricaded.
- The drain, pit, sewer & floor opening/ confined space checked for presence of toxic & flammable vapors.
- The level of oxygen inside the confined space checked & > 19.5%.
- Proper ventilation & lighting available/provided.
- The standby person is trained & deputed outside to watch the activity.
- The equipment isolated & LOTO applied.
- The proper scaffold / ladder provided & tied at the top.
- The 24-volt lamp used for lighting.
- The safety harness used & lifeline anchored above the work level.
- The required Personal Protective Equipment (SCBA or supplied air line hose mask (if necessary), leather/cotton hand gloves, safety glasses, safety shoes & Safety harness or belt) provided.
- The employees working in confined space are trained & training records are given to HSE before the start of work.
- The SOPs & Training records will always be available at the work place.

7. PERSONAL PROTECTIVE EQUIPMENT:

- ❖ PPE will be provided based on the hazard assessment. However the following
- ❖ PPEs will be used for carrying out work in confined space.
- ❖ SCBA or supplied air line hose mask (if necessary), leather/cotton hand gloves,
- ❖ safety glasses, safety shoes & Safety harness or belt

8. TRAINING: -

The operators are trained in the process as well as the High risks involved. They are trained on the High-risk activity procedures.

9. EMERGENCY PROCEDURE: -

- In case of any emergency we will contact the Emergency Telephone number.
- The Site Representative supervising the work will be intimated at the earliest.

10. PERIODIC INSPECTION OF PROCEDURES: -

The work instructions and safety procedures will be reviewed annually.

Signature of Contractor

Date:

ANNEXURE – 2

Construction Waste Management

Construction Waste Management at **BIRLA INSTITUE OF TECHNOLOGY** would include all waste generated on site starting from clearing of Site for soil excavation till the building is handed over to **BIT**. Building handover will be done only after all waste from that project has been properly managed.

Upon appointment the Contractor is required to prepare and submit to the Owner for approval, a project-specific Material management plan and a site management plan.

The Site management plan should include information on:

- Storage areas for various materials;
- Waste material stores;
- Approach routes to each store;
- Demarcation of area expected to have impact on top soil;
- Area demarcation for storage and preservation of top soil;
- Location of various bins considering the convenience of usage by the workers.

The Site plan needs to be made (and kept updated) keeping in mind the complete material movement i.e. generation of waste, disposal into bins on each floor, disposal into scrap yard and final reuse, recycle or disposal to landfill. Throughout the material movement no mixing should occur.

The material management plan shall specifically address the following:

- Material and waste management shall be part of the design co-ordination meetings;
- All material shall be tracked from material delivery to final use, waste generation and disposal. All materials shall be stored properly to ensure minimum damage;
- Top soil management and water management shall be considered a component of waste management;
- Sand needs to be stored properly to prevent loss during rainy season and contamination from organic matter;
- The concrete wash water shall be treated properly and reused and is not allowed to be disposed into waterways or percolation to ground water;
- All waste generated from the Site needs to be quantified. The various waste streams like plastic, cardboard, wood, cloth, debris, insulation material, metal etc. needs to be measured;
- The hazardous /electronic waste generated on the site needs to be managed in accordance to the legislations and also needs to be measured;
- All material safety data sheets (MSDS) should be available before a material delivery comes in. the storage areas should be prepared and material/waste managed in accordance to the MSDS;
- The various wastes that can be reused/recycled should be identified and relevant agencies contacted for collecting the waste;
- Waste segregation on each floor using bins or debris chutes needs to be done. This segregation should be done to ensure that the reuse/recycle potential of the particular stream of waste does not get reduced;
- Practical measures associated with works should be taken to prevent waste generation;
- Use building materials that are fully recycled and/or include recycled material in their production where practicable;

- Prevent pollution and damage to the environment;
- Report weekly the amount of waste removed from Site, reused, recycled or diverted productively from landfill;
- Any waste not diverted from the landfill shall be supported with a document stating the reason why it was not done. Also disposal should either be done through municipal/pollution control board approved vendors, or the private land owner who allows it should give land documents and a letter stating he is using it for filling low lying area;
- The maximum total quantity of waste accumulated on Site should not be more than 4 truckloads per project;
- The Contractor is responsible to ensure all electrical work should as per LOACL AUTHORITY requirements for waste management are met including waste minimisation.

Please use **Annexure 4** 'Construction Waste Management Guidelines' as recommendations for fulfilling the expectations under construction waste management. These are developed with a view to support the site team with the day to day implementation of CWM.

ANNEXURE – 3

Schedule of fines

Sl. No.	Nature of Offence	Amount of Safety or Environmental charge to be levied against the Sub/Contractor for each breach of the Owner's Rules & Regulations (Indian Rs.)
1	Unavailability of MSDS for chemical/hazardous materials	**Rs. 1000 per day**
2	Unsegregated piles	**Rs. 500 per day**
3	Improperly stored cement	**Rs. 1000 per day + damages**
4	Improperly stored non-hazardous material	**Rs. 500 + damages**
5	Improperly stored hazardous material	**Rs. 5000 + damages**
6	Cans/containers of hazardous chemicals found in the debris	**Rs. 5000**
7	Spill control for hazardous not being implemented	**Rs. 5000**
8	Spill control for non-hazardous not being implemented	**Rs. 500**
9	Transporter of waste found to dump it at unauthorized location	**Rs. 5000**
10	Missing bins on floors of construction site	**Rs. 1000**
11	Excessive Mixing of various waste streams in bins on floors	**Rs. 2000**
12	Improperly segregated waste being sent out of site as debris	**Rs. 7000**
13	Leaking water tankers	**Rs. 1000**
14	Weekly report on amount of waste removed from site not been submitted	**Rs. 1000**
15	Wastage of sand by not storing it properly	**Rs. 500 per day + damages**

Annexure 4
Construction Waste Management Guidelines

1. Best practices for construction and demolition waste

Role of contractor

- Identify two government authorized landfills (in consultation with the pollution control board) for disposal of construction waste. Only the government approved list of material will be disposed in these landfills.
- Identify a transporter authorized to carry the construction waste. The exit and entry of the waste at **BIT** site and the landfill respectively, should be signed off by the concerned security.
- Remove and transport debris in a manner that will prevent spillage during transport.
- Have designated bins/storage areas for various construction wastes.
- List out acceptable materials at each container and bin.
- Inspect containers and bins for contamination (hazardous material) and remove contaminated materials if found.
- Define the size of the storage areas based upon the type of waste, volume of waste generated and the availability of the hauler to clear the waste. Instead of storage areas, metallic bins that can be emptied using hydraulic trucks can also be used.
- Do not keep the waste stored for more than a month or four truck loads (less in case there is a limitation on area availability), whichever is earlier. In case of delays, the delay has to be explained with reason.
- Two separate material storage areas (long term and short term storage) need to be defined for convenience of operation. The long term storage requirement area should be well constructed as per the specific storage needs of each material. The short term storage would be for maximum 1-2 days of material storage and the location should be in proximity to the site.
- Provide adequate number of bins for food waste throughout the site.
- Appoint a waste management supervisor who is well aware of ways of managing construction waste. He/she would report to the facilities team.
- Follow all the laws and rules applicable for waste management including but not limited to Environmental Protection Act, hazardous waste management rules, etc.
- Follow the relevant IS standards, LEED, GRIHA etc.
- Have a debris chute system to systematically collect and dispose construction debris. This chute is typically a cylindrical shaped tube made of polyethylene/metal erected adjacent to an exterior wall and extending upwards to a window in the building. It should have an opening at each floor.
- A procedure to facilitate tracking of loads should be developed to prevent illegal disposal of waste.
- Ensure controlled movement of material within the project by having designated entry and exit points.
- Do not accumulate waste materials to be disposed of, on site.

- Do not burn or bury waste materials on or off site. Appropriate onsite topical application of ground gypsum or wood, or use of site paving as granulated fill is considered reuse, not waste.

- Have display boards for all types of material at the contractor office as shown below

Role of Contractor and Owner

- Develop a site plan including all the material storage areas, waste storage areas and the approach routes to these locations. Care should be taken not to cut off the approach routes during construction activities.
- A waste management plan should be developed by Contractor in consultation with the Owner.
- Ensure contractual clarity with the transporter/sub-contractor regarding material unloading, cleaning of spills, material management, packaging etc.

Important Note

- Heavy penalty would be imposed if the construction waste is not managed properly.
- Waste management would be included as part of the project review.

2. Top Soil

Role of contractor

- The top soil shall be tested to identify soil texture, nutrient quality, pH and mineral content and shall be conducted at a laboratory accredited by Indian Council of Agricultural Research.
- The topsoil shall be suitably amended for permeability, water holding capacity in line with the soil tests before re-application into planting zones. Topsoil amendments shall be carried out for improving bearing capacity before re-application as fill in non-planted areas.
- Clayey and Black Cotton soils shall be preferably stacked in low-lying areas or used immediately upon excavation in activities like natural lining for ponds.
- Clayey soil (non- black cotton) occurring on roads and plinth areas shall be amended to improve bearing capacity. Deep cutting and removal shall not be permitted.
- All site activities will be limited in strict accordance to a site demarcation plan. This site plan shall also show the areas on site from which top soil has to be gathered and designated areas where it will be stored.
- Photographic records with dates on the image shall be kept to show that the other areas have not been disrupted during construction.

- A site conditions document with cad drawings shall be created by the contractor showing site plan details of existing vegetation, existing buildings, existing slopes and site drainage pattern, staging and spill prevention measures, erosion and sedimentation control measures and measures adopted for top soil preservation during construction.

The following activities would be strictly done in consultation with the concerned person as mentioned:

- Top soil testing shall be done for road alignments, open spaces, planting areas and buildings as directed by the Landscape EIC/architect/ Civil engineer/ horticulturist.
- The stripping of topsoil shall be as directed by the EIC/ landscape architect only and shall be relaid with stable slopes on areas demarcated for that sole purpose and barricaded suitably.
- To protect top soil from erosion measures such as sediment basins, contour trenching, mulching, soil stabilization etc. shall be adopted as per the instruction of the landscape architect/ EIC.
- The landscape architect/horticulture contractor shall ensure that the stacked topsoil is re-laid to adequate depth for good vegetal coverage
- The boulders from excavation and road cuttings- especially ones with uniform/ artistic shape- shall be used as landscape elements within the campus or roadsides. They shall be crushed into aggregates for use as sub-base of roads only if allowed by the landscape architect/EIC.

3. Cement

Role of transporter

- Handle cement sacks carefully to avoid damage from sharp edges, by nails sticking out of the wooden pallets on trucks, by the pallets of forklift trucks, etc.
- Do not unload cement bags by using hooks.
- Transportation of cement can be done by using bulkers.
- Protect cement sacks from rain, drizzle, sea spray on windward coasts, splashes from small roadside waterfalls and streams in well watered mountainous areas, splashes from water in puddles and potholes, etc.

Role of contractor

- Cover the cement bags will tarps during transport within site.
- Do not drop cement bags from excessive heights.
- The walls of the storage area must be plastered and made damp proof.
- The roof must be given an appropriate water proofing treatment.
- The floor must be raised by at least 80 cm above the ground level to prevent any inflow of water. The flooring may consist of a 15 cm thick layer of dry bricks laid in two courses over a layer of earth consolidated to a thickness of 15cm above the ground level.
- For further protection, stack the cement bags at least 10-20 cm clear above the floor by providing wooden battens and planking arrangement. For saving timber concrete may be used.
- Place a sheet of plastic on the floor before storing cement bags on the top of it.
- Provide further protection from moisture by covering the bags with plastic sheet polyethylene.
- Ensure that the plastic sheet is not damaged anywhere.

- Do not use a newly constructed godown for storage of cement unless its interior is thoroughly dry.
- Pin a placard on each pile of cement indicating the date of manufacture of the stock.
- For temporary storage place the cement bags on a dry platform made of wooden planks resting over brick-masonry concrete, dry sand aggregates raised about 15 cms above the ground level.
- Do not adopt temporary storage or open storage in wet weather.
- Ensure that all the workers understand their role in material management.

Role of workers

- Do not stack the cement bags in contact with an external wall. Keep a clear space of at least 60 cm between the exterior wall and the stacks.
- Place the cement bags closely together in the stack to reduce circulation of air as much as possible.
- If the stack is more than seven bags high, arrange the bags in header and stretcher fashion (i.e.) alternately length-wise and cross-wise, to achieve interlocking between them and lessening the danger of toppling over.
- To avoid lumping or 'warehouse pack' under pressure, do not stack the cement bags more than ten bags high.(the number might change as given by the cement manufacturer)
- In case the bags are stored in excess heights and the warehouse effect occurs, remove it by rolling on the floor.
- Stack each consignment of cement separately in the godown.
- Keep the cement stack fully covered with tarpaulin or polythene sheet and protected against atmospheric moisture.
- Ensure that the covering sheets overlap each other properly.
- Store small amounts of cement remaining in opened sacks in undamaged plastic bags whose mouths are securely shut by twisting and then tying the twist with wire ties, twine, etc.
- When removing bags from storage, remove cement bags upto two or three tiers on the backside too rather than only from one tier on the front. If the rows are thus stepped back, there is less chance of over-turning of bags.
- When removing bags for use, apply the First in, First out (FIFO) principle i.e. take out the oldest cement first.
- Protective clothing must be worn at all times when working with cement, mortar or concrete.

4. Aggregates

Role of RMC (Contractor in case aggregate storage is on site too)

The aggregates should be protected from contamination. For this the following measures should be taken

- Locate your ground-level aggregate stockpiles on a hard base with good drainage. Keep them far enough apart or separate them with dividing walls which extend above the pile and two meters beyond the front of the pile.
- Provide the storage area with sheds to prevent contamination from rains and wind
- Do not allow leaves and other contaminants to fall into the aggregate stockpile
- Do not allow vegetation to grow in the aggregate stockpile.
- Do not allow adjacent aggregate stockpiles to overlap, causing cross-contamination.

Role of workers

- Do not drive trucks and loaders on aggregate stockpiles because their weight can break the aggregate particles and track mud and dirt into the piles.
- Do not scoop up underlying soil when using a front-end loader to move aggregate from a stockpile.
- Be sure to adequately shield dry, fine aggregate from the wind during handling in order to prevent the wind from separating the fine from the coarse material or blowing it away altogether.

5. Concrete

Role of RMC

- Prevent spills of concrete during transport and usage.
- Clean up any concrete spills.
- The transit mixer from the ready-mix concrete sub-contractor does not need to be washed after each use. A decision should be made regarding the number of times it can be used without washing depending on the time delay between two subsequent uses.
- The wash pit should be planned in a way to minimize the pollution to storm water or ground water.
- Explore the possibility of having a concrete recycling plant to reuse the aggregates and concrete wash water.
- Ready-mix concrete sludge from the wash pit can be sold or given to concrete block manufacturers. It was observed that ready mix concrete suppliers at Bangalore and Mysore follow this practice.

Role of contractor

- Perform both the slump cone and cube tests to evaluate the concrete quality while accepting the delivery of the ready mix concrete. In case a batch does not pass the slump cone test, it should be rejected.
- A record of the amount of concrete sludge or set concrete reused, recycled or disposed should be kept.
- Set concrete can be broken and used for backfilling or sub-base of roads.

6. Hazardous Materials

As defined by Hazardous Waste (Management, Handling and transboundary movement) Rules, 2008, hazardous waste means any waste which by reason of any of its physical, chemical, reactive, toxic, flammable, explosive or corrosive characteristics causes danger or is likely to cause danger to health or environment, whether alone or when with other wastes or substances. Since a lot of hazardous substances like paints, varnishes, water proofing material, solvents, and certain insulation materials etc. are used during construction; special care needs to be taken during their handling. All such material thus should be stored, transported, and disposed of in accordance with the Hazardous Waste (Management, Handling and Transboundary Movement) Rules, 2008.

Role of contractor/Owner

- Ensure that the vendor supplying the hazardous material is contractually bound to provide the material safety data sheets and take back the waste material and drums, cans etc.

Role of contractor

- Obtain all the material safety data sheets (MSDS) from the supplier.
- Store the materials according to the material safety data sheets.
- Do not overfill the drums in which the hazardous materials are stored.
- Locate the hazardous waste storage areas so as to prevent water pollution.
- It should be ensured that only designated personnel have access to the storage areas. For this mark the storage areas as hazardous material stores.
- Provide material specific first aid kits at/near the storage areas of respective materials.
- Display the expiry date of all materials on a placard near the respective material.
- All hazardous material must be used in accordance with the MSDS.
- Mark all hazardous wastes with a prominent skull and bone symbol.
- Identify all potential points of spill and leakage. This would help to be prepared in case of such events.
- At all such identified locations arrangements like use of trays for collection of spillage must be done.
- Keep records of all major spills.
- Dispose the hazardous waste to a licensed disposal facility.
- Treat the empty hazardous material storage cans as hazardous waste and send them back to the manufacturer or dispose of to an authorized disposal facility.
- Define designated areas for cleaning of brushes, equipment etc and mixing of hazardous materials.
- Ensure that the workers are well aware of the hazards of working with such material and their role in managing them.

Role of workers

- Clean the brushes and equipment used for the application of hazardous materials in designated areas.
- Store the water or solvent used for cleaning, separately as hazardous material.
- Do not carry the hazardous liquids in unmarked bottles.
- Wear protective gear at all times when working with hazardous materials.
- Contain spills by encircling with absorbent material (eg. Sawdust in case the material is not flammable) or constructing an earthen dike. This would limit the area of impact of the spill.
- Remove the absorbent material or contaminated soil promptly and dispose as hazardous material in the designated store.
- Do not bury or wash the spills with water.
- Do not mix the hazardous waste with non-hazardous construction site debris.
- Do not mix various kinds of hazardous wastes.
- Reuse any useful material when possible.

7. Metal

Steel is prone to corrosion and deterioration if it is allowed to be exposed to varying weather conditions and/or moisture. Since steel is one of the most cost intensive materials in site, its proper handling is of utmost importance.

Role of contractor

- Store steel so as to avoid distortion and prevent deterioration and corrosion.

- Protect exposed bars installed in the structure by covering with tarp or cement slurry when the exposure time exceeds 30 days.
- Store the steel scrap separately. Clear the scrap yard at regular intervals to avoid unnecessary accumulation on site.

In case steel needs to be stored in the open

- Place steel on top of wooden runners or some other sort of raised surface. Storing it in this manner will protect it from groundwater, which can cause corrosion over time.
- Cover the stored steel with a thick protective tarp to protect it from rain and atmospheric moisture.
- Keep the tarp in place by placing heavy concrete blocks on its corners and edges. This would prevent the tarp from blowing away during windy weather.
- Ensure that steel is not exposed outside for more than one month. In case of rainy season however it should be stored under shed.

All these measures would not only ensure that less steel is wasted, but also structural integrity of the infrastructure.

- Ensure that steel is reasonably clean when it is placed into concrete. A light amount of rust is acceptable, but not to the extent that it is pitted or the cross-sectional area is reduced.
- Take care that steel bars are prevented from getting distorted during use. Bending causes loss of strength of steel at the bent.
- Keep the cut pieces of the steel bars stored based on sizes and diameter so as to enable easy reuse.
- Reduce piping to straight lengths and store by type and size.
- Separate supports, hangers, valves, sprinklers, and other components by type and size.
- Prepare the steel cutting and bending plan keeping in mind the possibility of reuse of cut pieces.
- The records of the amount of steel bought, reused and sent for recycling should be maintained.
- The losses suffered from wastage of steel scrap generated, should be accounted for.
- Store the plumbing fixtures separately based on type and size

Role of workers

- Ensure that the steel cut pieces are stored separately based on diameter and size
- Keep the steel bars covered with the tarp.

8. Wood

Role of contractor

Wood is much more sensitive to the weather conditions than steel. Thus:

- Care should be taken to prevent the wood from getting wet.
- Store the wood clear from the ground to protect it from gaining moisture.
- Have proper ventilation and availability of light in the storage areas to avoid condensation of atmospheric moisture.
- Take informed decision regarding whether or not to treat wood for termite. The choice would be based on the intended use of wood and the probability of occurrence of termites in the particular geographical location.

- Store the wood waste thus produced segregated based on the reuse or recycle potential of wood and whether or not the wood has been treated for termites.
- While sawdust obtained from untreated wood can be used as a fuel in open, treated sawdust/wood should be combusted only in an industrial plant.
- Sawdust from untreated wood can also be composted.
- Sawdust can be used as an absorbent for spill protection.
- Clean Cut-Offs of Lumber can be grind or chipped into material appropriate for mulch or erosion control.
- Identify authorized recyclers for untreated wood waste.

9. Packaging material

Waste from packaging material is an unavoidable waste at the construction site. However if stored with care, it also has a huge potential for reuse and recycle. Mixing with construction debris leads to a deterioration in the quality of the packaging material.

Role of contractor

- Store cardboard, plastic, paper, cloth bags and wooden boxes in separate storage areas.
- Ensure that the segregation of these materials is done at source.
- Protect the material from damage due to weather during storage.
- Avoid contamination from any potential pollutants and mixing with construction debris.
- Temporary storage of packaging material could be done at each floor of the building.
- When possible, identify local recycling vendors.

Role of workers

- Dispose the different packaging material in designated bins and storage areas.
- Do not mishandle the packaging material, considering it to be a waste. (It is a resource in disguise)

Signature of Contractor

Date:

SECTION: 05

APPROVED MAKES

1. The make of some items are given as below, any other items will be used for the work after due approval by the Engineer In-charge:

2. In case of difference in make in the list and BOQ, The make of BOQ will be taken as final

7.1 Approved Make for Civil Works

Table 6: List of Approved Make

SR.NO.	MATERIAL	RECOMMENDED MAKES
1.	Cement bag all grades (Conforming to IS 8112)	Ultratech, Birla Super, ACC & Ramco
2.	Reinforcement Steel	TATA, SAIL, Jindal steel
3.	Ready Mix Concrete	Ultratech, ACC
4.	Epoxy	Fosroc, DR Fixit
5.	8”,6”,4” Concrete Block	Apco
6.	8”,6”,4” AAC Block	Ultratech Make
7.	M Sand & Soil	As per Engineer In-charge’s approval
8.	River Sand	As per Engineer In-charge’s approval
9.	40mm Jelly	As per Engineer In-charge’s approval

7.2

TECHNICAL SPECIFICATIONS
FOR PLUMBING WORKS

BIT

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SECTION - I GENERAL PROVISIONS

1.1 Scope

The General character and the scope of work to be carried out under this section is illustrated in the drawings, specifications and Bill of Quantities attached herewith. The contractor shall carry out and complete the said work under this contract in every respect in conformity with the rules and regulations of the local authority. The Contractor shall furnish all labour, materials, appliances, tools and equipment necessary for plumbing services installation including testing and commissioning as specified herein, and as per the relevant Bureau of Indian Standards (BIS), British Standards codes, and as shown on the drawings. This also includes any material, appliances and equipment not specifically mentioned herein or noted on the drawings as being furnished or installed which are necessary and customary to make a complete installation properly connected and in working order.

Carryout all incidental works connected with plumbing services installation such as excavation of trenches and back filling, cutting and chasing in concrete and brick and making good, cutting/drilling holes through walls, floors, and grouting for fixing of fixtures/equipment and so forth.

Furnish and install complete workable plumbing services installation as shown on the drawings and described in this specification and as per the latest Bureau of Indian Standards (BIS), British Standards (BS) specifications including all that which is reasonably inferred to all the buildings, internally and externally.

Complete installation of the sewerage and sewerage appurtenances internally as well as around the building.

Complete installation of all sanitary and plumbing fixtures in all buildings.

Co-operation with other trades for putting the installation in place. Any work done without regard or consultation with other trades, shall be removed by the contractor without additional cost to the Owner, to permit proper installation of all other work, as desired by the Engineer In-charge/Consultant.

Repair all damage done to the premises as a result of this installation and remove all debris left by those engaged for this installation to the satisfaction of Engineer In-charge /Consultant.

Cleaning of all plumbing and sanitary fixtures, testing and proving the satisfactory performance of all fixtures at the time the buildings are handed over to the Owner.

It is the responsibility of the contractor to take care of all the fixtures fitted until the time of handing over to the Engineer In-charge t/Consultant.

Painting of all exposed pipes as specified.

Assume full responsibility for getting the entire installation duly approved by the authorities concerned and for all expenses in connection with the same. Assume responsibility for obtaining and delivering to the Owner certificate of final inspection and approval by the concerned authorities

1.2 Regulations and Standards

The installation shall conform in all respects to the following standards in general:

2022 UPCI	:	2022 Uniform Plumbing Code – India
IS 7558 – 1974	:	Code of practice for domestic hot water installation
IS 5329 – 1983	:	Code of practice for sanitary pipe work above ground for buildings.

IS 12251 – 1987	:	Code of practice for drainage of building basements
Is 2064 – 1973	:	Code of practice for selection, installation and maintenance of sanitary appliances
IS 6924 – 1973	:	Code of practice for construction of refuse chutes in multistoried buildings
IS 1200 (Part 1)	:	Method of Measurement of building earthwork
IS 1200 (Part 16)	:	Method of measurement of laying of water and sewer lines including appurtenant
IS 1200 (Part 19)	:	Method of measurement of Water supply, plumbing and drains.
IS 783 – 1959	:	Code of practice for laying concrete pipes
IS 13592 – 1992	:	Specification for un-plasticized PVC pipes for soil and waste discharge system inside building including ventilation and rainwater.
IS 2527 – 1984	:	Code of practice for fixing rainwater gutters and down pipes for roof drainage.
IS 2685 – 1971	:	Code of practice for selection, installation and maintenance of sluice valves.
IS 6784 – 1984	:	Method of performance testing of water meters (Domestic type).
IS 12235 (Parts 1 to 11)	:	Methods of test for un-plasticized PVC pipes for portable water supplies.
IS 458 – 1988	:	Specification for precast concrete pipes (with or without reinforcement)
IS 2692 – 1989	:	Specification of ferrules for water services
IS 12701 – 1989	:	Specification for rotational molded polyethylene water storage tanks.
IS 771 – (Part 3 to 6)	:	Specific requirements for urinals

IS 2548 (Part 1 & 2)	:	Specification for plastic seats and covers for water closets.
IS 3004 – 1979	:	Specification for plug cocks for water supply purposes.
IS 1711 – 1984	:	Specification for self-closing taps for water supply
IS 1703 – 1977	:	Specification for ball valves (Horizontal plunger type) including floats for water supply purposes.
IS 4038 – 1979	:	Specification for foot valves for water works purposes.
IS 782 – 1978	:	Specification for Caulking Lead. (Third revision)
IS 1172 – 1983	:	Code of basic requirements for water supply, drainage & sanitation (revised).
IS 1239 – 1990 (Part I)	:	Specifications for mild steel tube, tubular and other steel pipe fittings.
IS 1239 – 1992 (Part II)	:	Specifications for mild steel tube, tubular and other steel pipe fittings.
IS 1726 – 1991	:	Code for cast iron manhole frame and cover (third revision).
IS 1742 – 1983	:	Code of practice for building drainage. (Second revision)
IS 2064 – 1973	:	Code of practice for selection, installation and maintenance of sanitary appliances.
IS 2065 – 1983	:	Code of practice for water supply to buildings.
IS 3114 – 1985	:	Code of practice for Laying of CI pipes
IS 4111 – 1986	:	Code of practice for Ancillary structures in sewerage system
IS 4127 – 1983	:	Code of Practice for laying glazed stone ware pipes.
BS 4515	:	Specification for un-plasticized PVC pipe fittings.
IS 4985 – 1988	:	Specification for un-plasticized PVC pipes for portable water supplies (second revision)

IS 732 & IS 2274 – 1963	:	Indian Standard code of practice for electrical wiring & installation.
IS 1536 – 1976	:	Specification for centrifugally cast (spun) iron pressure pipes for water, gas and sewage.
IS 1537 – 1976	:	Specification for vertically cast-iron pressure pipes for water, gas and sewage.
IS 1538 (Part-1 to 23) – 1976	:	Specification for cast iron fittings for pressure pipes for water, gas and sewage.
IS 1729 – 1979	:	Specification for sand cast iron socket and spigot soil, waste and ventilating pipes, fittings and accessories.
IS 780 – 1984	:	Specification for sluice valves for water works purposes.

Note: All IS Codes Latest year of Publication/ Revision to be considered.
National building Code for Water Supply, drainage and Sanitation. Part IX Plumbing services section 1 and 2.
The installation shall also be in conformity with the bylaws and requirements of the local authority in so far as these become applicable to the installation. Wherever this specification calls for, a higher standard of materials and /or workmanship than those required by any of the above regulations and standards, then this specification shall take precedence over the said regulations and standards.
Wherever drawings and specifications require something that may conflict with the regulations, the regulations shall govern. This shall be referred to the Engineer In charge for clarification.

1.3 **Drawings and Specifications**

The drawings and specifications shall be considered as part of this contract and any work or materials shown on the drawings and not called for in the specifications or vice versa shall be executed as if specifically called for in both.
The tender drawings indicate the extent and general arrangement of the fixtures, drainage system, etc. The drawings indicate the points of supply and termination of work shall be installed as indicated in the drawings. However, any changes found essential to co-ordinate with this work and other trades shall be made without any additional cost. The drawings and specifications are meant for the assistance and guidance of the contractor, and exact location, distance and levels will be governed by the individual building and site conditions. Therefore, approval of the Engineer In charge shall be obtained before commencement of work.

1.4 **Shop Drawings**

The contractor shall submit to the Owner four copies of the shop drawings.
Shop drawings shall be submitted under the following conditions:
Showing any changes in layout in the contract drawings.

Floor plans, enlarged toilet details, schematic showing water supply and sanitary installation works
Pumps/Equipment layout, control panel, wiring and piping diagram.
Manufacturers or Contractor's fabrication drawings for any materials or equipment.
The contractor shall submit four copies of catalogues, manufacturer's drawings, equipment characteristic data or performance charts as required by the Owner.
contractor should make a mock-up and get it approved from PMC/ Owners/ Engineer In-charge / Consultants before proceeding the work in Full Scale.

1.5 **As-built Drawings & Handing over requirements**

On completion of works, the Contractor shall submit three set of hardcopies along with soft copy in a pen drive to the Owner. All drawings shall be in AutoCAD latest version. These drawings shall have the following information:
Exact run and sizes of all piping on all floors and vertical stacks.
Ground and invert levels of all drainage pipes together with location of all manholes and connections up to outfall.
Run of all water supply lines with diameters, location of control valves, access panels.
Location of all mechanical equipment with layout and piping connections.
Contractor shall provide four sets of catalogues, performance data and list of spare parts together with the name and address of the manufacturer for all electrical and mechanical equipment provided by him.
All "Warranty Cards" given by the manufacturers shall be handed over to the Engineer In charge.
Detailed equipment data in the approved proforma
Approved test readings of all equipment and installations
Inspection certificates
List of recommended spares together with list of suppliers and their contact details

1.6 **Manufacturers' Instructions**

Where manufacturers have furnished specific instructions relating to the materials used in this job and methods of construction that are not specifically mentioned in these documents, such instructions shall be followed in all cases. The contractor shall also furnish detailed instruction and operation manuals in triplicate including detailed completion drawings and Fire Safety Plans to approved scale. Further it is the responsibility of the contractor to train the Owner's personnel in the operation and maintenance of the system.

1.7 **Materials**

Materials shall be of approved make and quality specified. They shall conform to the respective Bureau of Indian Standards, British Standards Specifications and supported by Manufacturing Certificate / test certificate.
Samples of all materials shall be as per the list of approved brands of manufacture, which shall be approved by the Engineer In charge before placing the order.
In any case of non-availability of materials in metric sizes, the nearest size of FPS units shall be provided with prior approval of the Engineer In charge at no extra cost to the owner.

1.8 **Guarantee**

The contractor shall guarantee both the material and workmanship of first-class quality corresponding to standard engineering practice. Any defective materials / workmanship shall be rejected; the contractor must rectify / replace at his own cost. Guarantee certificate of the materials supplied shall be handed over to the owner

SECTION - II SOIL, WASTE AND VENT PIPES AND RAINWATER PIPES

1.1 GENERAL REQUIREMENTS

Materials shall be of the approved make and quality specified. They shall conform to the respective Bureau of Indian Standards, British Standards Specifications, supported by Manufacturing Certificate and any other specification referred to herein.

Pipes and fittings shall be fixed truly vertical, horizontal or on slopes as required in neat manner.

Pipes shall be fixed in a manner as to provide easy accessibility for repair and maintenance and shall not cause obstruction in shafts, and in suspended ceilings.

Pipes shall be fixed securely to walls and ceilings by suitable pipe supports at intervals specified.

Access door for fittings and cleanouts shall be so located that they are easily accessible for repair and maintenance.

1.2 POLYVINYL CHLORIDE (PVC) PIPES AND FITTINGS

MATERIAL

Soil, waste & vent pipes shall be PVC pipes & fittings.

PVC (SWR) class pipes of Dia 75mm, 110mm and 160mm, of Type A for use in rainwater and ventilation and of Type B for soil and waste discharging system and conforming to IS 13592: 1992, shall be used. The pipes shall be supplied in nominal lengths of 2, 3, 4 or 6 meters, tolerance on specified lengths shall be +10mm and – 0mm. Any physical test requirements shall be as per IS13592-1992.

1.2.1 HANDLING

Because of their light weight, there may be a tendency for the PVC pipes to be thrown much more. Reasonable care should be taken in handling and storage to prevent damage to the pipes. Contractor should hold the fullest responsibility in this case. On no account the pipes should be dragged on the ground. Pipes should be always given adequate supports.

1.2.2 LAYING

The PVC pipes shall be laid under the floors below slab or on walls either buried or exposed as the case may be, as shown in the drawings. The minimum thickness of fittings shall be of 3.2 mm. the fittings shall be of injection mould type with solvent cement joint or rubber ring joint. The pipes and fittings shall be capable of withstanding sun's rays. PVC pipes laid below slab or suspended in ceiling shall be supported by angle brackets / supports as detailed in the drawings.

1.2.3 JOINTING

The jointing of pipes to fittings shall be done as per the manufacturer's instructions / recommendations.

The PVC pipes and fittings shall be joined with Solvent Cement and jointing shall be carried out as follows:

1. Cut the spigot end of the pipe square.
2. All burrs from the internal and external surfaces should be removed.
3. The spigot should be marked with a pencil line and a distance equivalent to the socket depth. Clean the surface within the marked area.
4. Apply uniform coat of solvent cement on the external surface to the pipe and a lighter coat on the internal surface of the fitting.
5. Insert the pipe end into the socket of the fitting and push it in up to the mark.

Remove the excess solvent cement and hold the joint firmly in position for 30seconds to dry. Gluing should be avoided in a rainy or foggy weather.

The other method of jointing shall be by rubber rings. The material of rubber ring should conform to IS 5382-1969.The ring is housed in groove formed in a plastic or metallic housing. The rubber is compressed and makes a seal between the pipe and housing. Lubricating paste should be applied before compressing the rubber. Where natural rubber rings are used, mineral oil or petrol or grease should be used.

1.2.4 TESTING

PVC pipes and fittings shall be tested for water tightness in accordance with IS 13592 - 1992. The openings of the pipes shall be sealed for the section to be tested. The water pressure of 1mtr water column to be applied for a period of 15 minutes. The Engineer-in-Charge shall examine carefully all the joints for leakage.

1.3 PVC PRESSURE PIPES AND FITTINGS

The PVC pressure pipes and fittings shall be used for conveying wastewater from wash basins, Urinals, kitchen sinks, floor drain connecting to washing machines, etc.

The pipes shall be class III, 6 Kg/cm2. PVC pipes and fittings shall be jointed with solvent cement. The pipes shall conform to IS 4985. Fittings shall be of injection moulded PVC conforming to IS 7634 (Part1) - 1975.

1.3.1 LAYING AND FIXING

The pipe laying and jointing shall be done in accordance with IS 7634 (Part 3) – 1975. Pipes shall be cut to size and chamfered well. Burrs if any shall be removed. Pipes and fittings shall be jointed using solvent cement or rubber ring joints. The pipes and fittings shall be jointed accurately without any stress to achieve leak proof joints.

1.3.2 TESTING

The method which is commonly in use is filling the pipe with water, taking care to evacuate any entrapped air and slowly raising the system to the test pressure. The water pressure of 1mtr water column to be applied for a period of 15 minutes.

1.4 CAST IRON PIPES

Cast iron pipes and fittings shall be of good and tough quality and dark grey on fracture. The pipes and fittings shall be true to shape, smooth and cylindrical, their inner and outer surface being as nearly as practicable concentric. They shall be sound and nicely cast, shall be free from cracks, taps, pinholes and other manufacturing defects.

The pipes and fittings shall conform to IS: 3989 as called for. Fittings shall be of required degree with or without access door. All access doors shall be made up with 3mm thick insertion rubber gasket of white lead and tightly bolted to make the fittings

air and watertight. The fittings shall be of the same manufacture as the pipes used for soil and waste.
All CI pipes and fittings shall bear the manufacturer's name and ISI specification to which it conforms.
All pipes and fittings shall be coated internally and externally with the same material at the factory; the fittings being preheated prior to total immersion in a bath containing a uniformly heated composition having a tar/other suitable base. The coating material shall have good adherence and shall not scale off. The coating shall be smooth and tenacious and hard enough not to flow when exposed to a temperature of 77 degree C but not so brittle at a temperature of '0' degree C as to chip off when scratched lightly with a pen knife.

All pipes and fittings before installation at site shall be tested hydrostatically to a pressure of 0.45 Kg/sq. cm without showing any sign of leakage, sweating or other defects of any kind. The pressure shall be applied internally and shall be maintained for not less than 15 minutes. All these tests shall be carried out in the presence of the representative of the Project Manager. Alternatively, a test certificate from manufacturers be obtained before despatch of material to site.

Cast Iron Specialties

If required, cast iron speciality items such as deep seal floor traps, urinal traps, trap integral pieces with integral inlet/outlet connections, manhole cover with frame, chamber cover etc. shall be fabricated to suit individual location requirements. The contractor shall arrange the fabrication of these items from an approved source.

Joints with Pig Lead/Drip Seal:

The approximate depth and weights of Pig Lead/Drip Seal for various diameters of CI pipes and specials shall be as follows:

Nominal size of Pipe (mm)	Lead per Joint (Kg)	Depth of Lead Joint (mm
50	0.77	25
80	0.88	25
100	0.99	25
150	1.5	38

SECTION - III STORM WATER DRAINAGE SYSTEM, SEWAGE SYSTEM

1.1 REINFORCED CEMENT CONCRETE (RCC) MEDIUM DUTY PIPES

These pipes shall conform to IS 458-1988 this shall be of class Non-Pressure (NP 3). The design and strength thickness and test requirements of pipes shall be as per table 2. Of IS 458.

1.1.1 LAYING AND JOINTING

The concrete pipe should be carefully loaded, transported and unloaded without impact, the laying of pipes shall be done by using tripod stand and chain pulley blocks or by using crane.

Joints shall be of collar joint, and the caulking space shall be filled with CM. 1:1 mixture of cement & sand. The caulking shall be employed on both the ends and finished neatly outside the socket at an angle of 450. Wooden caulking tool shall be used for forcing the mortar home into the collar.

All the joints shall be kept moist by means of wet gunny cloth to protect them from quick drying. The joints shall be cured at least for seven days.

1.1.2 TESTING

Testing of non-pressure pipes shall be subject to a test for 2.5 meters head of water at the highest point of the section under test for 10 minutes. The leakage or quantity of water supplied during testing shall not exceed 0.2 liters. /Mm Dia of pipes per Km length per day.

1.2 STRUCTURED WALL PIPES

These pipes shall conform to EN 13476 and shall be of class SN 8. Foam core/solid wall pipes can also be considered for this application.

1.2.1 LAYING AND JOINTING

Pipes shall be laid to the required gradients on a bed of well compacted granular material (quarry dust/sand) or selected as dug soil as per site conditions. The under bed shall be for the entire width of trench. The pipes shall be joined using fixed click ring and sealing ring.

Wherever cover above the crown of pipe is less than 0.6mtr and where cover above the crown of pipe is more than 2.5, pipes shall be provided with PCC (1:4:8) encasing with cover of 150mm all-round the pipe.

These pipes when laid under road, encasing shall be provided to avoid damages during construction by equipment's & too with stand load post construction.

1.2.3 TESTING

These pipes shall be tested for 1.2m of water head above the crown of pipe at the high end but not exceeding 6 mtr at low end. The loss of water over 30 minutes should be measured by adding water from a measuring vessel at regular interval and noting the quantity required to maintain the original water level. The quantity of water required should not exceed 1 litre per hour per linear kilometre per millimetre of pipe diameter.

1.3 MANHOLE AND INSPECTION CHAMBERS

Inspection chambers of Internal size 600 x 600mm up to a depth of 1.0M and manholes of varying sizes as per IS 4111 shall be constructed beyond 1.0M (depth of the manhole from the formation ground level).

1.3.1 LOCATION AND SIZES

The size indicated in the drawings shall be the internal size of chamber. Unless otherwise specified, manholes and inspection chambers are provided at all changes of direction of drains and where branch drain meets the main drain. Chambers shall be of such size as allow necessary examination and clearance of drains. The minimum internal sizes shall be taken as per detailed drawings; standards specified and local bye laws if any. In the absence of local byelaws, the requirements stipulated in IS 4111 (Part I) Code of Practice for Ancillary Structures on Sewage System shall be followed. The work shall be done strictly as per standard drawings and the following specifications:

1.3.2 BED CONCRETE

Bed concrete shall be in 1:4:8 cement concrete 150 mm thick for inspection chambers, 200 mm for depths up to 2 m and 250 mm for greater depths in case of manholes.

1.3.3 BRICK MASONRY

Brick work shall be with best quality table molded bricks in 1:5 cement mortar as per specification for brick masonry. The thickness of masonry shall be as per Bill of Quantities.

1.3.4 PLASTER

Inside walls of chambers/manholes shall be plastered with 15mm thick cement plaster 1:3 and finished smooth with a floating coat of neat cement. External walls shall be plastered in CM 1:3 mixed with waterproofing material and sponge finished.

1.3.5 BENCHING

Channels and benching shall be done in cement concrete 1:3:6 rendered smooth with neat cement. The following sizes of channels for the bench shall be adopted:

Size of Drain at walls	Depth of Centre	Depth at side's i.e.,
100 mm (4``)	150 mm (6``)	250 mm (10``)
150 mm (6``)	200 mm (8``)	300 mm (12``)

1.3.6 CHAMBER/MANHOLE COVERS

Covers shall be of heavy duty cast iron or fiber reinforced cement concrete as per material specification with lifting hooks as per IS 1726 - 1974 and as per the details given

in the drawings and fixed on CI frame or cement concrete embedded in concrete. Covers placed on the frames shall be airtight. The weight of frame and cover shall be as per bill of quantities.

1.3.7 STEPS

PVC steps shall be provided wherever the depth of the manhole/chamber is more than 1.2M. Steps shall be arranged in a staggered manner as per drawings.

1.3.8 DROP CONNECTIONS

In case the difference in invert levels between the main drain and the branch line requires a drop more than 600 mm, a drop connection should be provided with a PVC four way junction, fixed at right angles to the drop pipe at the level where the branch pipe enters the manhole. Access for cleaning the bend should be provided at finished ground level

1.3.9 GULLY TRAP CHAMBERS

PVC gully traps of specified size shall be provided as per relevant IS code. It shall be fixed on 15 cm. thick and 70 cm square 1:4:8 cement concrete bedding and the gully outlet shall be jointed similarly to the jointing of stoneware pipes. A brick masonry chamber 300 x 300 mm (internally) shall be constructed in 1/2 brick masonry with 1:6 cement mortar and the spaces between the trap and the wall shall be filled up with 1:3:6 concrete and the upper portion of the chamber shall be finished with neat cement. The corners and bottom of the chamber shall be rounded off so as to slope towards the grating and the bottom of the chamber shall not be less than 230 mm. In addition to 150mm x 150mm CI grating, the chamber shall have a CI frame cover (300mm x 300 mm). It shall then be placed on top of the brick masonry.

1.3.10 PE MANHOLES

PE-manholes are provided ready to connect. The delivery must be checked for completeness. All components must be checked for damage or contamination before installation and if necessary cleaned or replaced. Damaged components may not be installed! Pipe seals at the inlet are already inserted and the molded spigot at the outlet has the required nominal diameter. Inlet seal and outlet spigot are suitable for the direct assembly of PVC pipes according to DIN EN 1401, of PP pipes according to DIN EN 1852 and for PE-pipes according to DIN EN 12666 or DIN 8074. In special cases or if requested by customers, the Centre-drilling of the manhole ground, the insertion of the inlet seal or the fitting of the outlet spigot by sawing off can also be undertaken on the construction site.

All manholes are as per EN 13598-2 and inspection chambers as per EN 13598-1

All manholes supplied with corrosion resistant steps as per EN 13496:2001/EN 13101-1/DIN 1264-2
Inlet seals are watertight and comply with EN 681-1 standard.

1.3.10.1 Bedding

The minimum below the base required thickness is 10cm. The thickness of the lower bedding layer (sub-base) is according to EN 1610, Section 7.2 performed as „bedding type 1“.

1.3.10.2 Assembling and installing of the manhole

All the subsequent installation parameters are necessary to ensure permanent! For example, avoid with appropriate measures rinsing out fine material (by using fleece, crossbeam out of
Clay or similar).

1.3.10.3 Fitting inlet seal

In order to prepare the connection at the inlet side of the manhole ground, circular openings are to be produced with the help of core drills at the area marked for the respective nominal diameter. The core drill is to be positioned in a manner that misalignment of the pipeline can be excluded. The opening is to be deburred and cleaned. As next step, insert inlet pipe seal without using any lubricant. The precise fitting of the seal is to be checked.

1.3.10.4 Pipe connect ion inlet -side

Clean the inlet-pipe seal thoroughly before pipe assembly. The spigot of the inlet pipe is to be pushed into manhole ground in the inlet opening fitted with the inlet-pipe seal up to the stop, using sufficient lubricant. No joints are required between PE-manhole and inlet pipe.

1.3.10.5 Pipe connect ion outlet -side

The socket of the outlet pipe is to be slipped on to outlet spigot up to the stop, using sufficient lubricant. If necessary, the smaller, not required outlet spigot must be cut off perpendicularly with a saw. Afterwards, the cut-edge is to be deburred and cleaned. No joints are required between PE-manhole and outlet pipe.

1.3.10.6 Height adjustment

To adjust the height, shorten the neck of the upper unit. PE-manholes with diameters of DN 500 and DN 625 can be shortened to a maximum of 30 cm, with diameters of DN 800 and DN 1000 to a maximum of 25 cm. The cutting is to be done with a saw between two ribs of the upper unit. The resulting cut needs to be deburred.

1.3.10.7 Backfilling material

It is important to ensure that non-cohesive, well-graded (all sizes of material), compressible materials are used for backfilling. The maximum particle size of rounded gravel material shall not exceed 32 mm, and 16 mm if broken material is used. The backfilling material must meet the requirements of G1 or G2 according to ATV-A 127, section 3.1. The requirements of EN 1610, Section 5.3, or DWA-A 139, Section 7.1, must be followed.

1.3.10.8 Back-filling and compacting

The support area of the manhole base has to be stable and carried out in a flat, planar manner, in accordance with the planning specifications.

SECTION – IV SANITARY INSTALLATION AND FIXTURES

1.1 GENERAL

All fixtures shall be fixed in a neat workman like manner true to line and as recommended by the manufacturer or shown in the drawings. Care shall be taken to fix all fixtures, brackets and accessories by proper wooden cleats, rawl plugs, bolts and nuts.

Care shall be taken in fixing all approved chromium plated (CP) single lever fixtures and accessories so as not to leave any tool marks or damages on the finish. All such fixtures shall be tightened with fixed spanners. Use of `Stiltson' type pipe wrenches with toothed jaws shall not be allowed.

All fixtures shall be thoroughly tested after connecting the drainage and water supply system. All fixtures shall be thoroughly finished and any leakage in piping valves and waste fittings corrected to the complete satisfaction of the Consultant/Engineer.

Upon completion of the work, all labels, stickers, plasters, etc. shall be removed from the fixtures and all fixtures shall be cleaned with soap and water so as to present a neat and clean toilet.

1.2 INDIAN WATER CLOSET

Indian Water Closet white color Orissa pan type with porcelain `P` or `S` trap shall be provided with cistern with necessary accessories etc., as per BOQ. Indian Water Closet and trap shall be set in plain cement concrete 1:4 and flush with the floor.

1.3 EUROPEAN TYPE WATER CLOSET

The closet shall be white or colored as per BOQ and made of vitreous China and shall be of the best quality manufactured by an approved firm, and fixed by approved means. It

shall have 100 mm dia `P` or `S` trap depending on the location of water closets and soil stacks with effective seal. Each closet shall be provided with the following accessories:

a) Double flapped heavy urea formaldehyde seat cover of approved make quality and color with rubber buffers and C.P. brass screws fixed to the pan.

b) Concealed cistern with actuator of approved design.

c) 15mm C.P health faucet with angle valve.

d) Cast-iron chair or cantilever bracket for wall hung type with C.P bolt & nut.

1.4 WASH BASINS

They shall be white or colored as per BOQ and of vitreous China with best quality manufactured by an approved firm and size as specified. Oval/circular wash basins shall be supported on a RC counter with necessary steel reinforcement and rectangular wash basins with or without pedestals shall be supported by a pair of CI brackets of approved design... The washbasin shall be circular or oval shape below or above counter or rectangular with or without pedestal type as specified in Schedule of Quantities.

1.5 SHOWER UNIT

The shower unit shall be brass chromium plated wall mounted single lever wall mixer unit with CP spout and diverter. The shower unit shall be fitted with an overhead shower set comprising of shower arm, rose etc., complete with wall flange.

1.6 SINK

They shall be Stainless steel of best quality and shall be supported on necessary brackets. Each sink shall be provided with 40 mm CP waste coupling, CP bottle trap, and spout as per BOQ.

1.7 BATH TUB

Bath tub shall be of approved color made of acrylic plastic, comprising of Hot & cold mixer, with telephonic shower, overhead shower, Tub filler etc., complete with overflow arrangement, waste coupling.

1.8 TOILET ACCESSORIES

1.8.1 TOWEL RAIL

Towel rail shall be of C.P. with reinforced bends and circular flanges. The size of the rail shall be as specified. The bracket shall be fixed by means of stainless-steel screws to wooden/plastic cleats firmly embedded in the wall.

1.8.3 TOILET PAPER HOLDER

Toilet paper holder shall be of chromium plated as specified in the Material specification.

1.8.4 TOWEL RING

These shall be of CP as specified in the material specification. These shall be fixed by means of stainless-steel screws to wooden / plastic cleats firmly embedded in the wall.

1.8.5 SOAP DISPENSER

The Soap dispenser shall be wall mounted type tough ABS plastic with soap pouch and pump system as per list of recommended makes. The capacity of dispenser shall be 500 ml

a. SECTION – V WATER SUPPLY SYSTEM

1.1 GENERAL

1.1.1 Scope as per the attached scope of work.

1.1.2 Manuals

Three sets of all manuals for the systems shall be submitted to the client. This shall include instruction and maintenance manuals.

1.1.3 As-built Drawing

As built drawings as specified in the contract shall be submitted to the client on completion of work.

Drawing shall clearly show pipe routes, component details including

1.1.4 Training

It is the responsibility of the Contractor to train the Owner's personnel in the operation and maintenance of the system.

1.2 WATER SUPPLY SYSTEM

1.2.1 Water Meters

Water meters of approved make and design compatible to IBMS protocols shall be supplied for installation at locations as shown. The water meters shall meet with the approval of local supply authorities. Suitable valves and chambers or wall meter box to house the meters shall also be provided along with the meters.

The meters shall conform to relevant Indian Standard IS and International standards. Calibration certificate shall be obtained and submitted for each water meter.

Provisions shall also be made to lock the water meter. The provision should be such that the lock is conveniently operated from the top. Where the provision is designed for use in conjunction with padlocks, the hole provided for padlocks shall be a diameter not less than 4mm.

Installation of Water Meter

The G.I./ CPVC pipelines shall be cut to the required lengths at the position where the meter and stop cock are required to be fixed. Suitable fittings shall be attached to the pipes. The meter and stop cock shall be fixed in a position by means of connecting pipes, jam nut and socket etc. The stop cock shall be fixed near the inlet of the water meter. The paper disc inserted in the ripples of the meter shall be removed. And the meter installed exactly horizontal or vertical in the flow line in the direction shown by the arrow cast on the body of the meter.

Care shall be taken that the factory seal of the meter is not disturbed. Wherever the meter shall be fixed to a newly fitted pipeline, the pipeline shall have to be completely washed before fitting the meter.

1.3 CHLORINATED PVC PIPES (CPVC)

SCOPE

BIT

This specification covers requirements, test methods, and methods of marking for chlorinated poly (vinyl chloride) plastic hot-and cold-water distribution system components made in one standard dimension ratio and intended for water service up to and including 1800F (820C). These components comprise pipe and tubing, socket-type fittings, street fittings, plastic-to-metal transition fittings, solvent cements, and adhesives. Requirements and methods of test are included for materials, workmanship, dimensions and tolerances, hydrostatic sustained pressure strength, and thermo-cycling resistance. The components covered by this specification are intended for use in residential and commercial, hot and cold, potable water distribution systems.

The values stated in either inch-pound or SI units are to be regarded separately as standard. Within the text, SI units are shown in brackets. The values stated in each system are not exact equivalents therefore each system shall be used independently of the other. Combining values from the two systems may result in nonconformance with the specification.

Suggested hydrostatic design stresses and hydrostatic pressure ratings for pipe, tubing and fittings are listed in Appendix XI. Design, assembly and installation considerations are discussed in Appendix X2. An optional performance qualification and an in-plant quality control program are recommended in Appendix X3.

REFERENCED DOCUMENTS

ASTM Standards:

D 1598 Test Method for Time-to-Failure of Plastic Pipe under Constant Internal Pressure

D1399 Test Method for Short-Time Hydraulic Failure Pressure of Plastic Pipe, Tubing and Fittings.

D1784 Specification for Rigid PoIy (Vinyl Chloride) (UPVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds

D 1898 Practice for Sampling of Plastics

D2122 Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings2

D2444 Test Method for Impact Resistance of Thermoplastic Pipe and Fittings by Means of a Tup (Failing Weight)2

D2837 Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials2

F 402 Practice for Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and Fittings2

F 412 Terminology Relating to Plastic Piping Systems

F 493 Specification for Solvent Cements for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe and Fittines2

ANSI Standards:

ANSI B2.I-1968 Pipe Threads

ANSI Z17.1-1958 Preferred Numbers4

Federal Standard:

Fed. Std. No. 123 Marking for Shipments (Civil Agencies) 5

Military Standard:

MIL-STD-129 Marking for Shipment and Storage

NSF Standards:

Standard No. 14 for Plastic Piping Components and Related Materials6

Standard No. 61 for Drinking Water Systems Components—Health Effects
NSF Standards:
Standard No. 14 for Plastic Piping Components and Related Materials6
Standard No. 61 for Drinking Water Systems Components—Health Effects

DEFINITIONS
General—Definitions used in this specification are in accordance with Terminology F412, unless otherwise specified. The abbreviation for chlorinated poly(vinyl chloride) is CPVC. Plastic tubing denotes a particular diameter schedule of plastic pipe in which the outside diameter of the tubing is equal to the nominal size plus 1/3 in. (3.18 mm). Relation between standard dimension ratio, stress, and internal pressure—the following expression is used to relate standard dimension ratio, stress, and internal pressure for pipe and tubing:

$2S / P = R-1$

$2S / P = (D0/t) – 1$

Where:
S = stress in circumferential or hoop direction, psi (MPa).
P = internal pressure, psi (MPa),
Do = average outside diameter, in. (mm),
T = minimum wall thickness, in. (mm), and
R = standard dimension ratio, SDR.

Standard dimension ratio (SDR)—a. selected series of numbers in which the average outside diameter to minimum wall thickness dimension ratios are constant for all sizes of pipe and tubing in each standard dimension ratio, and which are the ANSI ZI7.I Preferred Number Series 10 modified by +1. SDR fittings shall by definition be equivalent in minimum socket wall thickness to the minimum wall thickness of the corresponding SDR and size of pipe or tubing, and the minimum body wall thickness shall be 125% of that value.

Standard material designation code—the chlorinated poly (vinyl chloride) material designation code shall consist of the abbreviation CPVC followed by two digits indicating the ASTM type and grade in Arabic numerals. Where necessary, a third and fourth digit shall be added to indicate the hydrostatic design stress for water at 730F [230C] in units of 100 psi [0.69 MPa].

MATERIALS
Basic Materials Description—Chlorinated poly (vinyl chloride) plastics used to make pipe, tubing, and fittings meeting the requirements of this specification are categorized by two criteria; namely, basic short-term properties, and long-term hydrostatic strength. Sections 4.1.1 and 4.1.2 respectively define these categories.
Basic Short-Term Properties—This specification covers CPVC 41 pipe, tubing, and fittings made from plastic materials meeting the mechanical strength, heat resistance, flammability, and chemical resistance requirements for CPVC 23447-B in Specification D 1784.
CPVC 23447-B was formerly designated as CPVC Type IV Grade 1, and is herein designated as CPVC 41. This is also used in marking pipe, tubing, or fittings.

BIT

Long-Term Hydrostatic Strength—this specification covers CPVC 41 pipe, tubing, and fittings which are further defined by hydrostatic design stress as CPVC 4120. Pipe and tubing are so defined on the basis of long-term hydrostatic strength tests and are made from compounds having an established 180°F [820C] hydrostatic design stress of 500 psi [3.45 MPa] or greater in accordance with Appendix XI and Test Method D 2837. Fittings are so defined by hydrostatic sustained pressure tests on fitting assemblies, required by this specification (see 6.2), and based on the hydrostatic strength of the corresponding pipe or tubing.
No hydrostatic design stress, as such, exists for finings until such time as long-term hydrostatic strength test methods for fittings are developed.
Rework Material—clean rework material generated from the manufacturers own production may be used by the same manufacturer provided the pipe, tubing, or fittings meet all the requirements of this specification.

Classification
Pipe, Tubing, and Fittings—This specification classifies CPVC 4120 pipe, tubing, and fittings by a single standard dimension ratio which shall be SDR II, by a maximum continuous use temperature which shall be 1800F [820C] and by nominal pipe or tubing diameters from 3/8 in.[9.5 mm] through 2 in. [50 mm].

Plastic-to-Metal Transition Finings—This specification classifies CPVC plastic-to-metal transition fittings intended for use up to and including 1800F [820C] as CPVC-I800F on the basis of resistance to failure by thermo-cycling.

Solvent Cements and Adhesives— this specification classifies solvent cements and adhesives meeting the requirements contained herein as CPVC Solvent Cement or CPVC Adhesive.

Requirements for Pipe, Tubing and Fittings
Dimensions and Tolerances:

GENERAL
Wall Minimums—Table 1 and Table 2 show wall thickness minimums. Calculated SDR 11 tubing wall thicknesses that fall below 0.068 in. [1.73 mm] shall be arbitrarily increased to that value. Calculated SDR 11 fitting wall thicknesses that fall below 0.102 in. [2.59 mm] for the fitting socket bottom, or 0.I28 in. [3.25 mm] for the fitting body, shall be arbitrarily increased to these values.

Interference Fit—The diameters and tolerances in Table I and Table 2 provide for socket-type joints having an interference fit based on the major diameter of pipe and tubing having a degree of out-of-roundness. This does not necessarily imply interference based on the minor diameter of the pipe or tubing.

Out-of Roundness—The maximum out-of-roundness requirements shown in Table 1 and Table 2 for pipe, tubing, and finings apply to the average measured diameter.

Pipe and Tubing:

BIT

Outside Diameter and Wall Thickness—The outside diameters and wall thicknesses for pipe and tubing shall meet the requirements for dimension and tolerance given in Table 1 when measured in accordance with Test Method D2122.

Wall Thickness Range—The wall thickness range for pipe and tubing shall be within 12 % when measured in accordance with Test Method D 2122.

Flattening—There shall be no evidence of splitting, cracking, or breaking when the pipe is tested in accordance with 9.2

Length— Pipe and tubing supplied in straight lengths shall have a tolerance on any specified length of +1/2 -0 in. [+12.5, -0 mm].

Socket-Type Fillings:
Dimensions—Fitting sockets, inside diameters (waterways), wall thicknesses, laying lengths, and reducing bushing minimums shall meet the requirements for dimension and tolerance given in Table 2. Table 3, and Table 4 when measured in accordance with Test Method D2122. The spigot ends of street fittings shall meet the outside diameter and minimum wall requirements of Table 1.

Alignment—The maximum angular variation of any socket opening shall not exceed 1/20 off the true centerline axis.

PLASTIC –TO-METAL TRANSITION FITTINGS
Back Dimensions—Plastic parts of plastic to metal transition fittings shall meet the dimensional requirements of Table 1 and Table 2 where applicable with the following exceptions. Such parts shall be exempted from the requirements for inside diameter (waterway) and wall thickness tolerance.

Thread Dimensions — Transition fittings that rely on interference fit and sealant shall be threaded with American National Standard Taper Pipe Threads meeting the dimensional requirements of ANSI B2.1

Thread Tolerance — The manufacturing tolerance on CPVC threads, measured with a ring gauge, shall be a maximum variation of 1½ turns large or small when measured in accordance with Test Method D 2122.

Starting Threads — The entering ends of external CPVC threads shall have a Blunt Start (see Fig. 1) produced by making the width of the thread at the start approximately 50 to 75% of the full thread. The Blunt Start provides for easy entrance and protection of the thread, and shall be included in the measurement of thread length.

HYDROSTATIC SUSTAINED PRESSURE
General — Pipe, tubing, and fittings (tested as assemblies) shall meet the minimum hydrostatic sustained pressure requirements of both test conditions shown in Table 5 when tested in accordance with 9.2.

BIT

Pipe and Tubing Quality—Test condition B shall be termed the primary sustained pressure test for pipe and tubing and shall be used for quality control (see Appendix X3). Test condition A shall be termed the secondary sustained pressure test for pipe and tubing and shall be used for periodic performance qualification. Failure to pass either lest is cause for rejection.

Fitting Quality—Test condition A shall be termed the primary sustained pressure test for fittings and shall be used for quality control (see Appendix X3). Test condition B shall be termed the secondary sustained pressure test for fittings and shall be used for periodic performance qualification. Failure to pass either test is cause for rejection.

Thermo cycling — Plastic-to-metal transition fittings (other than metal socket-type transitions for use with adhesives assembled according to the manufacturer's instructions, shall not separate or leak when thermo cycled 1000 times between the temperatures of 600Fand 1800F [160C and 820C] in accordance with 9.3.8

REQUIREMENTS OF SOLVENT CEMENT AND ADHESIVE JOINTS

CPVC Solvent Cements:
Note 6—CPVC solvent cements may exist which meet the requirements of the specification when used in accordance with the manufacturer's recommendations, without a primer or cleaner. It is recommended that those CPVC solvent cements which may be used without a primer or cleaner be dear or yellow in color. Otherwise, it is recommended that CPVC solvent cement requiring the use of 3 primer or cleaner be orange in color. Color identification is recommended to facilitate cement recognition to prevent the misuse of the cement and to the minimize the unintentional use of other cements that may fail at elevated service temperatures.

General—CPVC solvent cements, for use in CPVC 41, plastic-to-plastic, socket-type joints shall meet the requirements set forth in Specification F 493.

Hydrostatic Burst Strength—2-in. [50-mm] CPVC solvent cement joints shall exceed the minimum hydrostatic burst strength requirements given in Table 6 after a maximum drying interval of 2 h when tested in accordance with 10.1.3, Failure to pass the burst requirement at either temperature is cause for rejection.

Hydrostatic Sustained Pressure Strength—½-in. [I5-mm] CPVC solvent cement joints shall meet the requirements of 6.2 when tested in accordance with 9.3.

Safe Handling of Solvent Cement—Refer to Practice F402.

CPVC ADHESIVES

General—CPVC adhesives (other than CPVC solvent cement), shall qualify for use in CPVC socket-type joints by a rigorous simulated use testing program as further defined in 7.2.2 and 7.2.3. CPVC adhesives shall be tested in the largest size joint and in the exact type of joint for

which they are intended; that is, 2-in. [50-mm] plastic-to-metal or 2-in. [50-mm] plastic-to-plastic.

Hydrostatic Sustained Pressure Strength—Socket-type CPVC adhesive joints, made and cured according to the adhesive manufacturer's recommended procedure, shall not separate or leak when tested in accordance with 10.2 at the hydrostatic sustained pressure condition given in Table 7.

Thermo-cycling—Socket-type CPVC adhesive joints, made and cured according to the adhesive manufacturer's recommended procedure, shall not separate or leak when thermo-cycled 10000 times between the temperatures of 600F and 1800F [160C and 820C] in accordance with 10.2.

WORKMANSHIP, FINISH AND APPEARANCE

The pipe shall be homogeneous throughout and essentially uniform in color, opacity, density, and other properties. The inside and outside surfaces shall be semi-matte or glossy in appearance (depending on the type of plastic) and free of chalking, sticky or tacky material. The surfaces shall be free of excessive bloom, that is slight bloom is acceptable. The pipe walls shall be free of cracks, holes, blisters, voids, foreign inclusion, or other defects which are visible to the naked eye and which may affect the wall integrity. Holes deliberately placed in perforated pipe are acceptable. Bloom or chalking may develop in pipe exposed to direct rays of the sun (ultraviolet radiant energy) for extended periods and consequently these requirements do not apply to pipe after extended exposure to direct rays of the sun.

CPVC SCHEDULE 40 PRESSURE PIPES AND FITTINGS FOR WATER SUPPLY AS PER ASTM F-441

Outside Diameters and Wall Thicknesses For CPVC 4120, SDR 11 Plastic Pipe As Per ASTM D-2846								
Nominal Size (in.) (mm)	**Outside Diameter, in. (mm)**		**Wall Thickness, in. (mm)**		**Pressure Ratting. PSI ($Kg.Cm^2$)**			
	Average	**Tolerance**	**Minimum**	**Tolerance**	**73.4°F (23°C)**		**180°F (82°C)**	
½* (15)	0.625 (15.9)	± 0.003 (0.08)	0.068 (1.73)	+0.020 (0.51)	400	(28.1)	100	(7.0)
¾ (20)	0.875 (22.2)	± 0.003 (0.08)	0.080 (2.03)	+0.020 (0.51)	400	(28.1)	100	(7.0)
1 (25)	1.125 (28.6)	± 0.003 (0.08)	0.102 (2.59)	+0.020 (0.51)	400	(28.1)	100	(7.0)
1¼ (32)	1.375 (34.9)	± 0.003 (0.08)	0.125 (3.18)	+0.020 (0.51)	400	(28.1)	100	(7.0)
1½ (40)	1.625 (41.3)	± 0.004 (0.10)	0.148 (3.76)	+0.020 (0.51)	400	(28.1)	100	(7.0)
2 (50)	2.125 (54.0)	± 0.004 (0.10)	0.193 (4.90)	+0.023 (0.58)	400	(28.1)	100	(7.0)
* For ½" wall thickness minimum is not a function of SDR.								

BIT

MPa = Mega Pascal 1 MPa = 10 kg / cm2 1 kg / cm2 = 14.223343 PSI.

1.3.1 SUPPORT SPACING FOR PVC PIPE

Support and Spacing

To ensure the satisfactory operation of a PVC piping system the location and type of hangers should be carefully considered. Hangers should not compress, distort, cut or abrade the piping.

All piping should be supported with an approved hanger at intervals sufficiently close to maintain correct pipe alignment and to prevent sagging or geade reversal. Pipe should also be supported at all branch ends and at all changes of direction. Support trap arms as close as possible to the trap. In keeping with good plumbing practices support and brace all closet bends and fasten closet flanges.

Recommended Horizontal or Vertical Support / pipe clamping	
Pipe Size in inches	**Spacing in feet**
½ " to 1" (Cold)	5.0 (1.52 m)
½ " to 1" (Hot)	2.5 (0.76 m)
1¼ " to 2" (Cold)	6.0 (1.82 m)
1¼ " to 2" (Hot)	3.5 (1.06 m)

1.3.10 HANDLING:

The pipe should be handled with reasonable care. Because thermoplastic pipe is much lighter in weight, than the metal pipe. There is sometimes a tendency to throw it around. This should be avoided.

The pipe should never be dragged or pushed from a truck bed. Pallets for pipe should be removed with a fork lift. Loose pipe can be rolled down timbers, as long as the pieces do not fall on each other or on any hard or uneven surface.

In all cases, severe contact with any sharp objects {rocks, angle irons, forks on forklifts, etc.) should be avoided.

1.3.3 STORING:

If possible, pipe should be stored inside. When this is not possible, the pipe should be stored on level ground, which is dry and free from sharp objects. If different schedules of pipe are stacked together, the pipe with the thickest walls should be at the bottom.

The pipe should be protected from the sun and be in an area with proper ventilation. This will lessen the effects of ultraviolet rays and help prevent heat build-up. If the pipe is stored in racks, it should be continuously supported along its length. If this is not possible, the spacing of the supports should not exceed three feet (3').

When storage temperatures are below 32°F, extra care should be taken when handling the pipe. This will help prevent any problems, which could be caused by the slightly lower impact strength of PVC and CPVC pipe at temperatures below freezing.

1.3.4 Laying, joining, curing

1.3.4.1 Systems should be installed in a good and workmanlike manner consistent with normal industry standards and in conformance with all local plumbing, fire and building code

requirements. Failure to follow proper installation practices procedures or techniques can result in system failure, property damage or personal injury.
Pipe and fitting systems should be used for their intended purpose as defined by local plumbing and building codes and the applicable ASTM standard.
1.3.4.2 Follow manufacturers' instructions for all related products.

a. Cut pipe square. As joints are sealed at the base of the fitting socket. An angled cut may result in joint failure.
b. Acceptable tools include miter saw, mechanical cut off saw or wheel cutter. Wheel type cutters must employ a blade designed for plastics.
c. Remove all burrs from inside and outside of pipe with a knife-edge, file, or de-burring tool. Chamfer (bevel) the end of the pipe 10° -15°
d. Remove surface dirt, grease, or moisture with a clean dry cloth.
e. With light pressure, pipe should go one half to one third of the way into the fitting socket. Pipe and fittings that are too tight or too loose should not be used.
f. Use an applicator that is one half the pipe diameter. Too large an applicator will force excessive cement into the inside of small diameter fittings. Too small an applicator will not apply sufficient cement to large diameter systems.

1.3.4.3 Recommended initial set times Apply a full even layer of cement to the outside of a pipe and medium layer of cement to inside of a fitting. Assemble pipe and fitting socket until it contacts socket bottom. Give pipe a quarter turn. Hold pipe and fitting together until the pipe does not back out. See table for recommended cure times. Remove excessive cement from the exterior. A properly made joint will show a continuous bead of cement around the perimeter.

Testing Pressure System
Prior to testing, safety precautions should be instituted to protect personnel and property in case of test failure. Conduct pressure testing with water. DO NOT USE AIR OR OTHER GASES for pressure testing.
The piping system should be adequately anchored to limit movement. Water under pressure exerts thrust forces in piping systems. Thrust blocking should be provided at changes of direction change in size and at dead ends.
The piping systems should be slowly filled with water, taking care to prevent surge and air entrapment. The flow velocity should not exceed 1 foot per second.
All trapped air must be slowly released. Vents must be
N.B. : Primers are used in solvent cement joints of PVC plastic pipe and fittings as per ASTM F 656
Provided at all high points of the piping system. All valves and air relief mechanisms should be opened so that the air can be vented while the system is extremely dangerous and it must be slowly and completely vented prior to testing.
The piping system can be pressurized to 125% of its designed working pressure. However care must be taken to ensure the pressure does not exceed the working pressure of the lowest rated component in the system (valves, unions, flanges, threaded parts etc.) The pressure test should not exceed one hour. Any leaking joints or pipe must be cut out and replaced and the line recharged and retested using the same procedure

3.6 COLOUR CODE FOR WATER SUPPLY PIPES

Colour code for water-supply pipes shall be as per standard requirement. Details as mentioned below.

COLOUR CODE FOR GENERAL SERVICES				
SL NO	**DESCPRITION**	**GROUND COLOUR**	**FIRST COLOUR BAND**	**SECOND COLOUR BAND**
A	**WATER**			
1.0	Cooling	Sea green	French blue	------
2.0	Boiler feed	Sea green	------	------
3.0	Condensate	Sea green	Light brown	------
4.0	Drinking	Sea green	French blue	Signal red
5.0	Treated	Sea green	Light orange	------
6.0	Cold water from storage tank.	Sea green	French blue	Canary yellow

1.5 DISINFECTION OF THE PIPE NETWORK & DYE TEST

The entire water distribution network is to be disinfected by using residual chlorine of 0.2 ppm for a period of 2 (two) hours. If ordinary bleaching powder is used, the proportions will be 150 gm of powder to 1000 litres of water. The powder shall be mixed with water in the storage tank. If a proprietary brand of chemical is used, the proportions shall be specified by the manufacturer. When the storage tanks are full, the supply shall be stopped and all the taps on the distributing pipes are opened successively working progressively away from the storage tank. Each tap shall be closed when the water discharged begins to smell of chlorine. The entire chlorinated pipe network is to be flushed out with fresh water before the water supply system is put into operation for domestic usage.

Approved dye shall be added to the flushing water tank & all water points shall be visually checked to ensure that there are no cross connections. The flushing water supply shall be with addition of dye for a minimum of 3 days.

1.6 VALVES, STRAINERS AND PRESSURE GAUGES

1.6.1 GENERAL

This section deals with different type of valves like butterfly valves, gate valves, ball valves, check valves, balancing valves and Strainers and pressure gauges. The contractor shall refer to the approved make of materials specified in the document & relevant drawings.

Valves shall be provided on branch pipe connections to mains and at connection to equipment where indicated. All valves are to be located for easy access. All valves

shall be supported wherever necessary with MS brackets. Valves shall comply with IS 780 (Class I) for C.I sluice valves and IS 778 for G.M valves and tested.

Pressure gauges shall have outer diameter not less than 115mm with 10mm BSP full thread, brass body siphon and gauge cock of size10mm. Dial gauges shall have adequate response for the pressures encountered within the specified (Range 0-15Kg/sq.cm).

1.6.2 GATE VALVE

The primary function of a gate valve is for starting and stopping of flow. It has a disc actuated by a stem screw and hand wheel, moves up and down at right angles to the path of flow of fluid and seats against two faces to shut of flow. As the disc of the gate valve presents a flat surface to the direction of flow, this valve is only for starting and shutting the flow in the pipe.

These valves are of GM make. Supplying, fixing and testing corresponds to IS 778-1984, Specifications for Copper Alloy Gate, Globe and Check Valves for Water Works.

All globe and check valves shall have working parts suitable for hot and cold water, as required. Valves shall be tagged with permanent label under hand wheel indicating type or duty.

All valves should have manufacturer's test certificate indicating the date of shop test and other quality control tests with the material used for the same. Gate valves shall be of the size as specified in the BOQ.

Also, the following standard corresponds to their manufacture.

Design	-	API600/BS1414
Face to Face/ End to End	-	ANSI B 16.10
Flange Dimension	-	ANSI B 16.5
Butt Weld Ends	-	ANSI B 16.25
Pressure/ Temperature Ratings	-	ANSI B 16.34
Testing	-	API 598

1.6.3 BALL VALVE

The ball valve shall be of high-pressure type and shall be of sizes as specified in the BOQ. The normal size of a ball valve shall be that, corresponding to the size of the pipe to which it is fixed. Ball valves shall have body of carbon steel. The ball and the shaft shall be of stainless steel. The seat shall be of PTFE. The valve shall be complete

with socket weld ends and the float of copper sheet. The minimum thickness of copper sheet used for making the float shall be 0.45mm for a float exceeding 115mm dia. The body of the high-pressure ball valve when assembled in working condition with the float immersed to not more than half of its diameter shall remain closed against a test pressure of 3.5kg/sqcm.

The ball valve shall generally conform to IS specification No.1703:1977. The weight of ball cock and the size of the ball cock shall be as per IS specification.

1.6.4 FLANGES AND UNIONS

Sufficient number of flanges and unions shall be provided as required to facilitate maintenance work after the piping is installed. Mild steel flanges shall be used for pipes. The flanges shall be connected to the pipeline by screwing or welding depending on the requirement. The flanges shall conform to the relevant ASTM standard for the particular material used for its manufacture. The flanges shall also conform to IS 5211.

1.6.5 BRASS BIB COCK AND STOP COCK

A bib cock is a draw off tap with a horizontal inlet and free outlet and stop cock (stop tap) is a valve with a suitable means of connections for insertion in a pipe line for controlling or stopping the flow. They shall be of specified size and shall be screw down type. The closing device should work by means of a disc carrying a renewable non-metallic washer which shuts against water pressure on a seating at right angles to the axis of the threaded spindle which operates if. The handle shall be either crutch or butterfly type securely seated pattern. The cocks (taps) shall open in anticlockwise direction.

The bib cock and stop cock shall be polished bright (Chrome plated). The minimum finished weights of bib tap (cock) and stop tap (cock) as given in the IS specification are reproduced in the table:

	Minimum finished weight	
Size	Bib tap	Stop tap
Mm	kg.	Kg.
8	0.25	0.25
10	0.30	0.35
15	0.40	0.40
20	0.75	0.75

1.6.6 LEVEL SENSORS

Level sensor shall consist of control unit, preamplifier and one full insulated probe-mounted vertically or two-part insulated probe mounted from tanks side wall adjustable switching system for pump control application, the same to be housed in stove enamel painted cast aluminum weather proof suitable for black panel / wall mounting etc.,

The enclosure of probes shall be manufactured with SS316 material. The least count of the central unit with amplifier should be +/- 0.10mm for response value of 30 seconds.

1.6.7 LEVEL INDICATORS

A level control system with electronic level probes is mounted on the face of the reservoir. The top two-level sensors provide the ON-OFF signal for the treated water transfer pumps. A third level sensor enunciates a low-level alarm condition to the paging system and a fourth sensor enunciates an alarm to the paging system and stops the domestic water pumps from operating.

1.6.8 RELIEF VENTS

Drainage systems, especially those in tall buildings, are frequently found to develop extremely high and objectionable pneumatic effects in several specific portions of such piping. Special air pressure relief vents are recommended to control, within tolerable limits.

The air pressure relief vent, at least one-half the diameter of the building drain , should be provided at the top of vertical offset so as to supply such additional air to the drain as may be required by the sudden increase in liquid velocity in the vertical offset Where a building trap or other sharp change in flow direction is provided in the building drain downstream from the vertical offset ,an air pressure relief vent should be provided at the base of, and within 3 ft (0.900m) of, the vertical offset. Lower relief vent should be branch –connected to the upper relief vent at a sufficient height.

The recommended provision for soil and waste stacks more than ten stories in height is to provide a yoke relief vent at each tenth story of the drainage stack, counting downward from the top story. The lower end of the yoke relief vent should connect to the drainage stack by means of a Y located below the horizontal branch drain serving fixtures in that story, and the upper end should connect to the vent stack by means of a T or inverted Y located at least 3 ft (0.900m) above the floor level as shown in the drawing.

1.6.9 INSTALLATION OF VALVES

Valves should be installed in true tolerance of +/-5mm with respect to the center line of the pipe. Where threaded joints are encountered the threads should be initially sealed with PVC tape to avoid leakage due to improper tightening and leakage from threading.

Proper care has to be taken in welded installation so that the centerline of valve should not deviate from the pipe causing uneven load on the pipe and further stress during its operation. The welding should be done only after proper inspection of the joint by the Engineer-in-charge in the tacked position of the joint.

Before putting the line in operative mode, the valves should be checked for free and easy operation of the hand wheel. Any burrs or foreign materials should be removed by flushing before final operation so that no choking in the valves should occur which might damage the valve seating.

1.7 MANHOLE COVERS

The manhole covers shall be of heavy-duty type (cast iron) with double seal, locking arrangement and lifting hooks. (Weight 110kgs.) manufactured as per IS-1726. The shape of the cover to be as per the drawings.

1.8 WATER PIPE INSULATION

MATERIAL

Insulation material for Pipe insulation shall be Closed Cell Elastomeric Nitrile Rubber or closed cell cross linked polyethylene foam. Thermal conductivity of elastomeric nitrile rubber shall not exceed 0.038 W/moK or 0.0313 Kcal / Mhr oC or 0.212 BTU / (Hr-ft2-oF/inch) at an average temperature of 30oC. The product shall have temperature range of –40 oC to 105oC. Density of material shall not be less than 0.06 gm/cm3. The insulation shall have fire performance such that it passes minimum CLASS 1 as per BS476 part 7 for surface spread of flame. Water vapor permeability shall not exceed 0.024 per inch (3 x 10-14 Kgs / m.sec.Pa).

Thickness of the insulation shall be as specified for the individual application All joints shall be sealed properly with adhesive, which shall provide similar vapor barrier as the original insulating material.

All hot water piping shall be insulated in the manner specified herein. Before applying insulation, all pipes shall be brushed and cleaned. Thermal insulation shall be applied as follows or as specified in drawings or schedule of quantity:

Pipe size (mm)	Thickness of Nitrile rubber insulation
15 mm to 25 mm	9 mm
32 mm to 50 mm	13 mm
65 mm and above	19 mm

Insulation for pipes in wall chase and for pipes in shaft / plant room.

Insulating material in tube form shall be sleeved on the pipes. On existing piping, slit opened tube from insulation shall be placed over the pipe and adhesive (as recommended by the manufacturer) shall be applied as suggested by the manufacturer. Adhesives must be allowed to tack dry and then press surface firmly together starting from butt end and working towards centre.

Wherever flat sheets shall be used it shall be cut out in correct dimension. All longitudinal and transverse joints shall be sealed as per manufacturer recommendations. The insulation shall be continuous over the entire run of piping, fittings and valves. All valves, fittings, joints, strainers etc. in hot water piping shall be insulated to the same thickness as specified for the main run of piping and application shall be same as above. Valves bonnet, yokes and spindles shall be insulated in such a manner as not to cause damage to insulation when the valve is used or serviced.

All insulation work shall be carried out by skilled workmen specially trained in this kind of work. All insulated pipes shall be labeled (HWS / HWR / HWRR).

Protective Coating over Insulation

To provide mechanical strength and protection from damage & UV rays all exposed pipe insulated with nitrile rubber shall be covered with fiberglass fabric or UV paint as per BOQ. The fiberglass fabric shall be applied with one coat of fireproof epoxy or acrylic compound. The coat shall be allowed to cure to non-stick state. Subsequently second coat of compound shall be applied to give a tough and smooth finish to the insulated surface. UV paint shall be water-based or compatibility with insulation used shall be confirmed by the manufacturer.

Measurement Of Insulation

Unless otherwise specified measurement for pipe insulation for the project shall be based on Centre line measurements described herewith

Pipe Insulation shall be measured in units of length along the Centre line of the installed pipe, strictly on the same basis as the piping measurements. The linear measurements shall be taken before the application of the insulation. It may be noted that for piping measurement, all valves, orifice plates and strainers shall not be separately measurable by their number and size. It is to be clearly understood that for the insulation measurements, all these accessories including valves, orifice plates and strainers etc. shall be considered strictly by linear measurements along the center line of pipes and no special rate shall be applicable for insulation of any accessories, fixtures or fittings whatsoever

1.9 VALVES

1.9.1 Location

Valves shall be provided on branch pipe connections to mains and at connection to equipment where indicated. All valves are to be located for easy access and are to be full bore of pipe connected together. All valves shall be supported wherever necessary.

1.9.2 Specification

Valves for copper pipes and fittings shall be 70/30 dezincification resistant brass. The valve shall be copper to copper and the internal part made of material resistant to dezincification.
From 54 mm and above valves shall be provided with metric flange connection either with bimetal flange (steel outer with Gun metal inside) or with brazing metal slip-on flange.
The on-line valves shall be copper to copper ball valves with stainless steel or dezincification resistant brass internal parts.
All valves shall be compatible to use with copper pipes and fittings.

2.0 PUMPS

2.1. HYDROPNEUMATIC SYSTEM & PUMPING MAINS

2.1.1 SCOPE

This section of the contract involves the design, supply, installation, testing and commissioning of the complete Hydro pneumatic pumping system and other pumping systems complete with all controls and electrical work for domestic water supply, water supply for flushing and for cooling tower make-up. All submersible water re-circulation, drainage and ejector pumps for the project are also included in this contract. It also involves testing and commissioning of the pumping system with the domestic water and flushing water supply & distribution.

This specification described the particulars of the contract, designs and systems chosen, and mode of operation.

All installation work shall comply with the latest rules and regulations.

The work embraced by these specifications covers the design, submission to authorities, supply, delivery on site, installation, testing, commissioning and maintenance of the Hydro pneumatic pumping system, other pumping system installation of the building in accordance with this specification and associated drawings.

The scope of work shall include the following (list is indicative and not exhaustive) :

- Variable speed pumping units' domestic water & flushing water supply & distribution.

- Suitably sized food grade quality, non-toxic diaphragm type pressure vessels complete with necessary interconnections and controls.

- Control panel for pump control complete with variable speed drives, circuit breakers, fusses, pressure transmitters etc. complete with all interconnections to pumps and electrical supply panels.

- Pump control units complete with pre-programmed micro-processor chip.

- Pump monitoring units to monitor operation of pumps.

- Each Hydro pneumatic Pumping unit shall be supplied as a complete set including variable speed pumps, pressure vessels suction and discharge common manifolds, non-return valves, isolating valves, pressure gauges, pressure transmitters on the discharge side and level electrode, flexible, strainers at the suction tank. Each unit shall be provided with electronic microprocessors for unit control and all necessary electrical work for the unit.

- Submersible water re-circulation pump for water fountain, drainage pumps for plant room drainage complete with electrical panels and necessary accessories with automation for pump operation.

- All the pipe work etc. shown in the system drawings is meant for information only and shall be carried out by others. The Hydro pneumatic system supplier shall provide the pumping units in the designated pump rooms as complete units included all necessary piping within plant such that only discharge connections are required to be connected into the unit's discharge manifolds just inside the plant room, by the Plumbing contractor. The Hydro pneumatic system contractor shall guarantee specified pump performance at various pump speeds and Hydro pneumatic pumps must be able to supply at least 2 bar pressure at the highest/farthest fitting.

- Electrical equipment and installation work including the PLC in Control panel.

- Painting and labeling of pipe work and equipment;

- Provision of all hold down bolts, spigots struts and the like required to be built in during construction;

- Provision of dry contacts to BMS indicating the status of the pumps and pressure vessel in form of hardware interfacing panels inside each pump room and control panels of all pumps.

- Provision of all level switches, flow switches and other sensing devices for status indication.

- All interfacing work with other trades.

- Testing and commissioning and balancing of the Hydro pneumatic & Pumping system;

- Provision of twenty-four (24) months operational maintenance and breakdown services;

- Provisions of operating instructions and maintenance manuals;

- Provision of spare parts;

- Training of the employer's staff for proper operation of the entire systems;

- Liaison with Local Authorities to obtain all necessary certificates and approvals, including the completion of all submission drawings, forms and payment of any fees and charges. All the costs for all the tests required by Local Authorities shall be included. To attend to any Authorities inspection regardless of whether this inspection is carried out after the defect liability period;

- Provisions of the necessary installation which include pumping works, pipework within the pumping unit up to suction and discharge manifolds, conduit and control wiring, etc. to form a workable system required;

- All other works and systems as specified in the Contract document and or shown on the drawings.

- All cutting, patching, framing up, furring in, chasing and making good associated with the building construction for the passage of pipes, conduits and the like including providing GI pipes sleeves of required size corresponding to pipe dia, wherever pipes crossing fire rated walls and floors and sealing with glass wool in between and fire sealant compound on either end. Details on shop drawings shall also be provided.

2.1.2 GENERAL

Equipment offered for supply and installation shall include the following:

All minor items and incidental work, equipment accessories and materials may not be specifically mentioned but are required for the proper completion of the installations in accordance with the true intent and meaning of this Specification.

All necessary safety devices for the protection of personnel against injury and the protection of plant and equipment against damage including relief valves, belt guards, fan inlet and/or discharge guards, safety railing, effective earthing of electrical components, electrical interlocks, warning lights and alarms.

Readily accessible, dust-proof lubricating facilities on all moving parts and equipment including provision for cleaning all lubricating lines and bearings and charging same with the correct lubricants after installation but prior to testing and commissioning.

Clearly visible and robust manufacturer's name-plates permanently fitted each and every item of equipment and showing the manufacturer's name, type and/or model number, serial number, and all essential operating data such as speed, capacity, voltage, current draw, etc.

The Contractor also shall allow provision for the inspection of all plant and equipment by the manufacturer or his licensed representative, at least twice during the course of the installation.

2.1.3 PIPING

The pipes and fittings in the domestic Water Treatment plant room shall be GI class `C' (heavy class) conforming to IS: 1239 (Part-I) for pipes and IS:1879 (Part 1 to 10) for malleable cast iron galvanized fittings.

2.2 PUMPS FOR HYDROPNEUMATIC & DRAINAGE SYSTEM

2.2.1 PUMPS

Pumps shall be vertical, centrifugal, multistage directly coupled to motor. Provision of pump with pump head & base of cast iron and other parts including impeller in SS 304, shaft in SS316 construction, mechanical seal of Tungsten Carbide shall be made for pumps required in Hydro pneumatic System and water fountain re-circulation system. Impeller shall be hydraulically balanced and keyed to shaft. Pump shall be mounted on a concrete foundation, projecting at least 15 CM above finished floor level. The pumps base shall be set on a vibration elimination pad. The pump shall be lubricated in strict accordance with the manufacturer's instructions and shall be factory aligned prior to shipment. All motors and bases shall be painted with approved finish shop coat of paint. The pump shall be selected for the lowest operating noise level and shall be complete with flexible connections, valves, and pressure gauges. The pumps shall include cost of foundation channel complete.

The Contractor shall supply and install pumps of the type and performance as shown on the drawings. All duties of pumps given in the Tender Drawings shall be checked and where necessary corrected before ordering. All the parts of the pumps that are in contact with water e.g. shaft, impeller etc. shall be of stainless-steel construction.

Pumps shall be so selected that the design duty point is within 5% of the maximum efficiency point. The pump casing so selected shall have ample space to take an impeller one size larger than that capable of performing the design duty.

The pump shall have a speed of not more than 1500 rpm. However, pumps of 2900 rpm with high efficiency and low noise motor can be selected and noise data submitted for approval. All pumps and motors shall be of minimum vibration and noise level during operation. Vibration isolators shall be provided for all pump sets.

Facilities shall be provided to prevent starting of pumps when the water tank is at low water level. An indicator for this low water level alarm shall be provided.

Facilities to select which pump to be duty pump and standby pump shall be provided and be interchangeable.

Leakage from pump gland shall be drained to the nearest floor waste.

Pump curves for all pumps offered shall be submitted before procurement action for client's approval. All curve indicating excessive shut-off head will not be approved.

Each pump shall be provided with a gate valve at suction and discharge, approved check valve at discharge, approved strainer at suction, flexible connections at pump suction and discharge, eccentric reducer at suction, concentric reducer at discharge, pressure gauges at suction and discharge, circulation relief valve and automatic air relief valve.

Appropriate neoprene vibration isolation mountings shall be provided for each pump sets.

Vertical Multi-Stage Pumps

Multi-stage pumps shall be of centrifugal type and arranged with shafts vertically installed. The impellers shall be of stainless steel mechanically balanced and keyed to shaft. Renewable guide rings are to be provided in the casting, keyed to prevent rotation.

Pumps shall be driven by elevated in-line TEFC squirrel cage motors via extended vertical shafted complete with universal couplings.

The shafts shall be stainless steel. Stainless steel sleeves shall be provided to protect the shaft in the water space and through the sealing glands. The sleeves shall be keyed to prevent rotation and secured against axial movement.

The bearings shall be of ball or roller type protected against ingress of water, dirt and other matter.

Vertical multistage pumps shall have universal flanges. Intermediate bearing, support bearing shall be provided in the pump.

The shaft seal shall be easily serviceable and shall allow for correct adjustment and loading of the seal. Pump motors above 7.5 kW shall be equipped with a spacer coupling which allows changing of shaft seals without removing the motor. The pump motors shall be of Class "F" insulation and IP55 rating and shall be provided with built-in thermostats for protection against overheating.

2.3 VARIABLE SPEED HYDROPNEUMATIC PUMPING SYSTEM

Variable speed Hydro pneumatic pumping units shall be provided for supply of domestic water, flushing water supply for the project. The units shall be selected so as to provide at minimum of 2 bar pressure at the highest/farthest fitting in each plumbing system, the unit serves. The hydro pneumatic pumping units shall have the following features ;

2.3.1 System Description

The system shall be supplied as complete sets including suction and discharge common manifolds, non-return valves, isolating valves, pressure transmitter on the discharge side and electrode at the suction tank.

The system operation will be such that the initial small water demand shall be met by the charged diaphragm pressure vessel. Should the water demand continue the system pressure will dip to a preset pump cut-in point when the lead pump starts to operate at reduced speed through the variable speed drive. However, should the system pressure be still below the preset value, the controller continuously increases pump speed to meet the system demand. When the lead pump is not able to meet the system pressure at full speed, the second pump also starts to operate.

At peak demand all the pumps operate, Similarly, if there is a drop in water demand the duty pump speed starts to reduce, then standby pumps cuts-off, followed by stopping of the duty pump.

The closed diaphragm pressure vessel shall be of polyethylene material with a pressure gauge and isolating valve. The interior shall be of non-toxic lining suitable for use with potable water. The vessel shall be manufactured to conform to ASME pressure vessel code/standards.

The system shall be under the control of an electronic microprocessor unit (EMU).

A pressure transmitter shall detect the pressure at the delivery manifold and feedback to the microprocessor control panel via control circuit.

The system shall incorporate a frequency converter or frequency converter motors on the pumps and the pressure transmitter shall register the actual pressure on the discharge side.

The variable speed drive pumping system shall maintain a constant pressure regardless of the system demand. If there is a drop in pressure outside the preset point, the Variable Speed Drive (VSD) pump shall start to run until the pressure increases to the preset limit, or it will continue to increase the pump speeds to the upper limit of the frequency. If the water system demand still cannot be met, the second pump shall be called in to run, the VSD will then alter the pump speed to meet the preset pressure point. If the set point is still unable to be met, the third pump is then activated to run (in case of 3 pumps units).

This shall be achieved by continuously varying the motor speed of the duty pump according to the demand up to a maximum designed capacity.

Under decreasing hydraulic demand, the reverse sequence to the above description shall apply.

The EMU shall ensure alternation of all the duty and standby pumps for even running hours for all the pumps.

The frequency converter shall be linked to the motor of the duty pump for continuous speed adjustment and ultimately the water delivery shall be maintained at constant pressure at the preset value.

2.3.2 Local Motor Control Panel

The motor control panel shall be equipped with all the necessary electrical components including a microprocessor control unit and a frequency drive. The control panel and the microprocessor shall cover the followings functions :

- Flexibility and simplicity in allowing the necessary re-adjustment of the pumping system pre-set delivery pressure to operate the pumps within the specified maximum and minimum delivery ranges.

- Built-in frictional loss compensation factor which will automatically increase the delivery pressure setting, in collaboration with the increase in flow demand. This shall be able to minimize the system pressure differences and provide a more constant pressure along the supply line and also to save the energy consumption of the motor when running at low speed.

- Automatic changeover of the pumps to be controlled by the microprocessor which dictates the duty and standby pumps to run at variable speed as per the programming to be done.

- All pumps shall be provided with overload protection & starters shall be provided with single phase preventer.

- Built-in clock functions with weekly programming and with switch on system to operate at at least 10 different pre-set pressure points as required.

- When the system has not been operated for more than 24 hours, it shall automatically start the pumps for a few seconds/days to ensure the pumps readiness at all times. The standby pumps shall be activated upon failure of duty pump(s). In event of control failure, the pumps shall be able to be start/stopped manually at the local panel by means of pressure switches.

- The microprocessor control panel shall be able to cut-off the pumping system when excess pressure is registered in the discharge common manifold.

- The system shall have the capability of receiving input signal concerning reduced water level in suction tanks and shall have control mechanisms to prevent the pumps form running dry.

- Automatically starting the pumps when the water level is back to normal.

- In case of pump failure due to motor overload, the standby pump is switched on automatically. Alarm signal is displayed on the LCD Display unit and alarm lights are activated.

- Functions to limit the no. of start/stop of pumps per hour.

- The system control panel shall incorporate at least the following components :

a. LCD Display

b. Pumps selections for up to 4 pumps so that system controller can control up to 6 pumps

c. Pump status button to display duty pump speed and system capacity

d. Zone status button to display operating parameters for different pumping units

e. Setting button to input preset pressure, system start/stop time etc.

f. ±1 button to key in numeric data such as pressure set point, etc.

g. Enter button for confirmation of input into the system

h. Alarm button to show location of fault - self diagnostic function display

i. Hour Run measurement for each supplied pump set

j. Buttons for scrolling to select the actual display reading for system configuration, i.e. up and down scroll concept.

l. Necessary devices for programming, supervising and monitoring operation data/system, status shall be incorporating into the control panel.
The complete system shall be monitored through Building Management system. Necessary contacts shall be provided by the contractor.

2.3.3 Operations

Local control panel shall perform as follows :

<u>Auto mode</u>

The desired delivery pressure within the range specified, shall be set at the duty local control panel. The pressure transmitter shall detect the delivery pressure continuously within 1 second and feedback to the microprocessor which will control the variable speed drive frequency converter for speed control of the duty pump.

When demand increases, the subsequent pumps in the system will be activated to boost up the pressure. Ultimately the duty pump set shall be operated fully automatically to maintain the delivery pressure constantly at the desired set value.

Manual Mode

The on/off function of the pumps shall be manually adjusted at the microprocessor located at the local control panel.

Frequency Control By-pass Mode

All the pump sets shall be started/stopped automatically with the pump output at fixed maximum rotational speed. All the control and protection functions shall remain active. The cut in/cut out pressure shall be internally calculated by the microprocessor for each pump.

2.3.4 System Features

The required performance features of each Hydro pneumatic pumping unit shall be as follows :

System Configuration

Variable speed pumps with pressure vessels.

Control panel consisting of the following components :

- Pump Functional Unit (PFU) - control unit c/w pre-programmed microprocessor chip. This unit shall control all pumping unit operations through electronic controller.
- Pumping Monitoring Unit (PMU) - monitor the operation of the pump sets. This unit shall allow for monitoring and setting of all control parameter.
- Variable Speed Drive
- Circuit Breakers
- Fusses
- Pressure Transmitter

Set Point

Ten separate pressure “set points” shall be able to be programmed into the PMU, and switching between set points is timed by a real time clock when a lower pressure is acceptable during certain periods, for instance after hours or weekends, the set point shall be lowered to minimize power consumption.

An external input shall also be used to switch between set points, or manually adjust a set point at any time.

Friction Loss Compensation

It shall be possible to allow for the friction loss component of the system, calculated at full flow and set as a percentage of the set point which will reduce the working pressure of the pump set depending on the actual no. of pumps in operation. A linear approximation of system resistance curve can therefore be allowed for, and pressure will automatically increase as system flow and subsequent frictional losses increase. As such power consumption shall reduce which is required for the pumping system.

Displays

Through the PMU keypad all variable parameters shall be adjustable, current status of settings and measured values shall be able to display on the 2-line x 24-character liquid crystal display.

Individual menus shall be available for monitoring individual pumps, zones, settings, alarms and ON/OFF functions.

Pump Status

Running hours of each pump
Actual pump status (running, not available, standby, allocated to zone, fault)
Maximum head of pump at zero flow.

Setting Menu (Set)

In this menu all parameters for the operation of the pump set shall be able to be adjusted as required.

a Set points (up to 10)
b. On/Off function (used to prevent unnecessary cycling at low demands)
c. Displayed pressure units (Bar, PSI, mBar, kPa)
d. Real time clock programming for any time of the day, week, or weekend
e. Zone configuration
f. Friction loss compensation

Alarm

The alarm menu shall display all faults that occur during operation, logging the time and date of when the fault occurred and when it was corrected, or whether it is still an actual fault, up to 10 faults can be maintained as history in the controller. The following type of faults shall be diagnosed by the controller.

a. Mains failure
b. Frequency converter fault
c. Analogue input (pressure transducer) fault
d. High discharge pressure fault
e. Low discharge pressure fault
f. Motor thermal overload fault

Variable Frequency Drive

Variable frequency drive shall be of a reputable make acceptable to Project Manager and shall be complete with RFI filter and harmonic dampers.

Enclosure
An IP 54 powder coated steel enclosure shall house all the electrical components.

The enclosure can be supplied loose for remote mounting, or mounted on a common base with the pumps, it shall be adequately ventilated for use in conditions up to a maximum ambient temperature of 45 degrees Celsius.

Electrical Componentry

All circuit breakers, thermal overloads and contactors shall be of reputable make acceptable to the EIC. Electrical supply to the pump controller shall be protected using an isolating circuit breaker.

Method of Starting

The panel shall be built to start the pumps in suitable starting modes, i.e. D.O.L., Star/Delta, or using Soft Starters.

Quality and Testing

Manufacture of the pumps, plus design and assembly of the complete packaged Hydro pneumatic pumping system shall be factory assembled and the pump station shall be fully tested hydraulically and electrically prior to dispatch to site. Test reports etc. shall be submitted for review before dispatch.

2.3.5 Pump Pressure Vessel

Diaphragm type pressure vessels shall be provided as shown on the drawings. They shall be incorporated into the system so that during normal operation the pump shall not need to be start within 30 seconds of it switching off in order to prevent the pump hunting.

The pressure vessel shall be of adequate capacity to accommodate a considerable fluctuation in water demand by the system with minimum start/ stop cycles of the pumps. The vessel shall be constructed of steel plate built to ASME Standards for

Unfired Pressure Vessel. A rubber diaphragm shall be provided in the vessel for separating the water and pre-charge nitrogen. The pre-charge pressure shall be adjustable and charging port with non-return device shall be provided. The adjustable cut-in and cut-off pressure unit for the pumps shall be built-in at the vessel to suit the system.

2.4 SUMP PUMP

2.4.1 Submersible

These shall be fully submersible with a fully submersible motor. The pumps shall be provided with an automatic level controller and all interconnecting power and control cabling which shall cause the pumps to operate when the water level in the sump rises to a preset level and stop when the preset low level is reached.

Pumps for drainage shall be single stage, single entry.

Pump shall be C.I. casing and C.I. two vane open type with a dynamically balanced impeller connected to a common shaft of the motor. The vane for sewage pump will be open type, while for drainage pump, etc. it will be of semi open type. The MOC of the sump shall be in accordance to schedule of quantity.

Stuffing box shall be provided with mechanical seals.

Each pump shall be provided with a suitably rated induction motor suitable for 415 volts, 3 phase, 50 Hz A.C. power supply.

Each pump shall be provided with in built liquid level controller for operating the pump between predetermined levels.

The pumping set shall be for stationary application and shall be provided with pump connector unit. The delivery pipe shall be joined to the pump through a rubber diaphragm, and bend and guide pipe for easy installation.

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

Sump pumps shall be complete with level controllers, power and control switch gear, Auto/off/Manual switches, pumps priority selections and control and power cabling up to motor and controller/probes etc. (Including earthing). Level control shall be such that one pump starts on required level, 2^{nd} pump cuts in at high level and alarms is given at extra high level. All level controllers shall be provided with remote level indications.

2.4.2 Motor Design

The pump motor shall be a squirrel cage induction, housed in air filled water-tight enclosure. Oil filled motors are not acceptable. The stator windings shall be Class "F"

insulation (155 degree C or 311 degree F) for general usage and class `H' insulation (180 degree C or 317-8 grade 2) for submersible type.

The stator shall be heat shrunk fitted into the enclosure and shall not use bolts, pins or other fasteners that penetrate through the stator enclosure. The starter shall be equipped with a thermal switch embedded in series in the coils of the stator windings to protect the stator from wheel.

The motors shall be designed for continuous running duty type at 415 volts, 3 phase, 50 Hz power supply and capable of sustaining a minimum of 20 starts/stops per hour.

Between stator housing and pump, a tandem seal arrangement will be provided with an oil barrier. Both seals run in oil, allowing dry running without seal damage. Both seals shall be of the rubber bellows or metallic bellow type with positive drive between shaft and rotating seal face.

List of Approved Makes - Plumbing		
Sl. No.	**Item Description**	**Approved Makes**
1	CPVC Pipes and Fittings	Astral
		Supreme
		Ashirvad
2	Upvc Pipes & Fittings - Pipes as per ASTM D1785 & Fittings as per ASTM D 2466 & 2467	Astral
		Supreme
		Ashirvad
3	Upvc SWR Pipes and Fittings- IS 13592	Astral
		Supreme
		Ashirvad
4	PVC Pressure / Agri Pipes - IS 4985	Astral
		Supreme
		Ashirvad
5	Underground Drainage Pipes - IS 16098-1	Astral
		Supreme
		Ashirvad
6	DWC Pipes IS 16098 (Part 2)	Astral D-rex
		Supreme
		Alcorr
7	CI - Hubless pipes & Fittings	Neco
		Kapilansh
		BIC
8	GI / M.S Pipes (IS : 1239 and IS : 3589)	TATA
		Jindal
		Surya
9	GI pipes fittings	Unik

BIT

		Zoloto-m
		NEW
10	GI pipe sealent	Henkel - LOCTITE 55
		Master Seal
		Neoseal
11	RCC Hume Pipe	Local Approved
12	Pipe clamp & supports	Hitech Supports & Hangers
		Easyflex
		Fischer
13	Brass Ball Valves	NVR
		Sant
		Zoloto
14	Buterfly Valves	NVR
		Sant
		Zoloto
15	Check Valve / Non return Valve	NVR
		Sant
		Zoloto
16	Y Strainer	NVR
		Sant
		Zoloto
17	Air Release Valve	Zoloto
		Sant
		NVR
18	Pressure Reducing Valve	Hawk
		RB
		Varie
19	Electro Magnetic Flow meter BMS compatable	Pride
		Fluitec
		Omicron
20	Water meter - NON IBMS Mechanical Type	Kranti
		Capstan
		Deshmesh
21	Pressure Guage	H.GURU
		FIEBIG
		WIKA
22	Anticorrossive Material	I W L
		RUSTECH
		Pypkote
23	Paint	ASIAN
		BERGER
		NEROLAC
24	Level Controller & Indicator	Lehry instrumentation
		Aqua intel

BIT

		Sri vinayaka
		Filpro electronics
25	Expansion Bellows, Anti Vibration Mounting & Flexible Connections	Easy Flex
		Resisto Flex
26	Anchor Fasteners	Hilti
		Fisher
27	Insulation for Hot Water Pipes	Armaflex
		K-Flex
		A-Flex
28	Grease trap	ACO
		Kessel
29	Back flow preventer (uPVC)	Ashirwad
		Astral
		Supreme
30	FRP Manhole frames &Covers	Everlast
		Thermodrain
		AAGAM
31	D.I. Manhole covers and frames	HP NECO
		Cresent Foundry
		RBAC
32	Solar Panels	Rashmi
		Emvee
		Bipsun
33	Heat Pump	Vindsol
		Klima
		Exergy
34	Pumps	Grundfos
		Mechlion
		KSB
PHE – RELATED ELECTRICAL WORKS		
1	CONTROL / POWER CABLES	RR Cables
		APAR
		KEI
		Havells
		Polycab
2	MCCB	ABB
		SCHNIEDER
		SIEMENS
		LEGRAND
3	CONTROL MCB	ABB
		SCHNIEDER
		LEGRAND

BIT

4	VOLT METER SELECT SWITCH	SALZER
		L & T
		KAYCEE
5	VOLTMETER (AC / DC)	ELMEASURE
		SECURE
		SELEC
		CONZERVE
6	AMMETER (AC / DC)	ELMEASURE
		SECURE
		SELEC
		CONZERVE
7	POWER CONTACTORS	L&T
		SCHNEIDER
		ABB
		LEGRAND
		Siemens
		TEKNIC
8	PUSH BUTTONS	TEKNIC
		SIEMENS
9	AUTO / MANUAL SELECTOR	L & T ESBEE SALZER
		KAYCEE
10	TIMERS	EAPL
		SCHNEIDER
		LEGRAND
11	TERMINAL BLOCKS	WAGO
		ELMEX
12	CURRENT TRANSFORMERS	KALPA
		SELEC
		KAPPA
13	OVER LOAD RELAY	L&T
		SCHNEIDER
		ABB
		LEGRAND
14	SINGLE PHASE PREVENTORS	MINILEC
		POWER TEK
15	END TERMINATIONS	Dowells
		HMI
		Comet
16	CABLE TRAY	Profab
		Pushpal
		Classic

7.3

FIRE PROTECTION
TECHNICAL SPECIFICATION

BIT

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GENERAL REQUIREMENTS

1.1 Scope

The General character and the scope of work to be carried out under this section is illustrated in the drawings, specifications and Bill of Quantities attached herewith. The contractor shall carry out and complete the said work under this contract in every respect in conformity with the rules and regulations of the local authority. The Contractor shall furnish all labour, materials, appliances, tools and equipment necessary for Fire Protection services installation including Manufacture / Fabrication, supply, storing, installation / erection, testing, commissioning the fire hydrant system, Hose Reel system, Sprinkler system, first aid fire extinguishers & Signage and quoted rates should include complete earth works i.e., excavation, back filling for the buried pipes wherever applicable & with all necessary accessories as per Specifications and National Building Code of India, at Birla Institute of Technology Ranchi. Furnish and install complete workable plumbing services installation as shown on the drawings and described in this specification and as per the latest Bureau of Indian Standards (BIS), British Standards (BS) specifications including all that which is reasonably inferred to all the buildings, internally and externally.

Co-operation with other trades for putting the installation in place. Any work done without regard or consultation with other trades, shall be removed by the contractor without additional cost to the Owner, to permit proper installation of all other work, as desired by the EIC/Architect/Consultant.

Repair all damage done to the premises as a result of this installation and remove all debris left by those engaged for this installation to the satisfaction of EIC/Architect/Consultant

Note: Main feeders to the Fire MCC panel shall be given by electrical vendor and all the cabling from MCC panel to pumps shall be Fire Vendor Scope.

1.2 Regulations and Standards

Unless specifically mentioned otherwise, all the applicable Codes and Standards published by the Bureau of Indian Standards and their subsequent revision / BS Standards shall govern in respect of design, workmanship, quality and properties of materials and method of testing; standards listed below shall be applicable, in particular:

NBC	:	National Building Code of India Part IV for Fire Protection System
IS-1239 / IS 3589	:	Specification for GI Pipes
API 600 / BS 5163	:	Specifications for Gun Metal gate, globe & IS778/780/2906 check Valves for water supply.
IS-800	:	Specifications for Structural steel

IS-814	:	Specifications for covered electrodes for metal for welding of structural steel.
BS-5155	:	Specifications for C.I. Butterfly valve.
IS-4927	:	Specifications for Canvas Hose Pipes.
IS-903	:	Specifications for Branch pipes Fire hose couplings and auxiliary equipment's
IS-5290	:	Specifications for hydrant landing valves.
IS-1200	:	Method of measuring of building & civil Engineering Works (Water supply, plumbing drain & sanitary fittings)
IS-4853	:	Recommended practice for radiographic inspection of fusion welded butt joints in steel pipes
IS-636	:	Synthetic, jacketed hose pipes
IS-2198	:	Control Panels
IS-2159	:	Hot dip galvanizing of iron and steel
IS-5	:	Specification for painting
IS 9137		Specification for horizontal end suction centrifugal pump
BS-1965 Part I	:	Specification for butt-welded Pipe Fittings
IS 8423	:	controlled percolating hose for fire fighting
IS 2871	:	Branch pipe, universal for firefighting purposes
IS 884	:	First aid hose reel for fire fighting
IS 15683	:	Code of practice for selection, installation and maintenance of portable first aid fire extinguishers
IS 937 :		Specification for washers for water fittings for fire Fighting system
IS 9972	:	Specification for automatic sprinkler heads
IS 2171	;	Dry chemical powder type Fire extinguishers

1.3 Drawings and Specifications

The drawings and specifications shall be considered as part of this contract and any work or materials shown on the drawings and not called for in the specifications or vice versa shall be executed as if specifically called for in both.

The tender drawings indicate the extent and general arrangement of the Installation of the system, etc. The drawings indicate the points of supply and termination of work shall be installed as indicated in the drawings. However, any changes found essential to co-ordinate with this work and other trades shall be made without any additional cost. The drawings and specifications are meant for the assistance and guidance of the contractor, and exact location, distance and levels will be governed by the individual building and site conditions. Therefore, approval of the Engineer In charge shall be obtained before commencement of work.

1.4 Shop Drawings

The contractor shall submit to the Owner four copies of the shop drawings.
Shop drawings shall be submitted under the following conditions:
Showing any changes in layout in the contract drawings.
Pumps/Equipment layout, control panel, wiring and piping diagram.
Manufacturer's or Contractor's fabrication drawings for any materials or equipment.
The contractor shall submit four copies of catalogues, manufacturer's drawings, equipment characteristic data or performance charts as required by the Owner.

1.5 As Built Drawings

On completion of works, the Contractor shall submit three set of hardcopies along with soft copy in a CD to the Owner. All drawings shall be in AutoCAD R14 or later version.
These drawings shall have the following information:
Exact run and sizes of all piping on all floors and vertical stacks.
Location of all mechanical equipment with layout and piping connections.
Contractor shall provide four sets of catalogues, performance data and list of spare parts together with the name and address of the manufacturer for all electrical and mechanical equipment provided by him.
All "Warranty Cards" given by the manufacturers shall be handed over to the Engineer In charge.

1.6 Manufacturers' Instructions

Where manufacturers have furnished specific instructions relating to the materials used in this job and methods of construction that are not specifically mentioned in these documents, such instructions shall be followed in all cases. The contractor shall also furnish detailed instruction and operation manuals in triplicate including detailed completion drawings and Fire Safety Plans to approved scale. Further it is the responsibility of the contractor to train the Owner's personnel in the operation and maintenance of the system.

1.7 Materials

Materials shall be of approved make and quality specified. They shall conform to the respective Bureau of Indian Standards, British Standards Specifications and supported by Manufacturing Certificate / test certificate.
Samples of all materials shall be as per the list of approved brands of manufacture, which shall be approved by the Engineer In charge before placing the order.
In any case of non-availability of materials in metric sizes, the nearest size of FPS units shall be provided with prior approval of the Engineer In charge at no extra cost to the owner.

1.8 Guarantee

The contractor shall guarantee both the material and workmanship of first-class quality corresponding to standard engineering practice. Any defective materials / workmanship shall be rejected; the contractor has to rectify / replace at his own cost.
Guarantee certificate of the materials supplied shall be handed over to the owner.

2 EQUIPMENT SPECIFICATIONS

2.1 FIRE HYDRANT SYSTEM

1.0 Without restricting to the generality of the foregoing, the fire hydrant system shall include the following:

1.1 Fire water pumps, prime movers, Base plates, Couplings, suction / delivery pipes, Valves and Instrumentation for automatic operation etc.

1.2. Galvanized Iron (G.I) Class "C" (heavy grade) fire riser main within the building and K9 DI pipes outside the building.

1.3 Landing valves, hose reels, hose cabinets, fire brigade connections and connections to pumps and appliances.

1.4 All materials shall be of the best quality and brand new, conforming to these specifications and subject to the approval of the Client / Employer.

1.5 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.

1.6 Pipes and fittings shall be fixed to walls and ceilings by suitable clamps at intervals specified. Only approved types of anchor fasteners shall be used for RCC ceilings and walls.

1.7 Pipes and fittings shall be fixed truly vertical, horizontal or in slopes as required in a neat manner.

1.8 Valves and other appurtenances shall be as located that they are easily accessible for operation, repairs and maintenance.

1.9 Pipes for wet risers within the Building shall be G.I Pipes conforming to IS 1239 (heavy duty 'C' class) with flanged/welded joints.

1.10 Fittings for black steel pipes shall be malleable iron of approved type.

1.11 Inter connection between sprinkler and hydrant pumps shall be carried out at discharge side with check valve and isolation valves.

1.12 Construction of Fire water tanks, Fire water pump house, Puddle flanges at water tanks for suction / delivery / test lines and core cutting / opening if required on wall is exempted for Fire protection contractor.

2.2 PIPING

All pipes inside the building and where specified, outside the building shall be G.I Pipes. Tubes conforming to IS: 1239 - heavy duty. Fittings for pipes shall be as per IS: 1239, Part II (heavy grade) up to 150mm dia. Pipes 200 mm dia. and above shall be as per IS: 3589 with minimum 6 mm wall thick & fittings shall be fabricated from pipes confirming to IS 3589.

Pipes shall be carefully laid to the alignment, levels and gradients shown on the plan and sections and great care shall be taken to prevent any sand, earth or other matter from entering the pipes during laying. Pipes shall be kept thoroughly clean during the course of laying. The ends of pipes shall be blocked with wooden plugs wedged home at the end of each day work to prevent dirt and rodents, insects etc., entering the pipe.

Pipes shall be Installed with Grooved Fittings as per relevant IS/International Standard

Screwed tee shall be provided for Sprinkler tapings.

Delivery header of Hydrant and sprinklers shall be provided with Pressure gauge and also at the tapping of Hydrant and sprinkler riser at the top most floor.

2.3 EXCAVATION / THRUST BLOCKS

Excavation for pipe lines shall be in open trenches to line and grade or as required at site including disposal outside of site at approved dumping yard with the prior approval of concerned authorities. Pipe lines shall be buried to a minimum depth of 1M (top of the

pipe) from the finished ground level. The contractor shall support all trenches or adjoining structures with adequate timber supports wherever required. On completion of testing and painting of the pipe lines, trenches shall be refilled with excavated fine earth in 20cm layers and consolidated by ramming and watering.

2.4 VALVES

Butterfly valves shall be as per BS 5155 & provided for pipes 50mm dia and above. The valves shall be CI construction; seat shall be black nitrile rubber with inset moldings. The valves shall be PN 1.6 rating. All valves shall be connected with supervisory switch for monitoring at Fire alarm panel. Cabling shall be done by other agencies.

2.5 EXTERNAL HYDRANTS

Yard hydrant valves shall be as per IS: 5290 (Type A). The valves shall be complete with hand wheels, quick coupling connections, springs and blank caps. The hydrants shall be fixed to stand posts of 80mm dia for single headed hydrants at 1.0M from ground level. External hydrant valves shall be single headed type as specified in Schedule of Quantities.

2.6 HOSE REEL

Contractor shall provide standard fire hose reels with 19mm dia high pressure rubber braided hose of specified length with gunmetal nozzles and control valve, shut off valve, all mounted on a circular hose reel drum of mild steel construction and cast-iron / M.S. bracket. The hose reel shall be installed in fire hose cabinet / fire duct inside the building.

2.7 LANDING VALVE AND HOSE PIPE

The landing valve (internal) shall be gunmetal double headed type conforming to IS: 5290, complete with hand wheel, quick coupling, spring and blank cap. RRL type hose pipe shall be 63mm dia and 15m length as per IS: 636 with 63mm dia. Instantaneous pattern type Gun metal heavy duty couplings as per IS : 903, Gun metal Branch pipe and nozzle shall be as per IS : 903 & to be provided in the fire hose cabinet. The fire hose cabinet shall be as per Bill of Quantities.

2.8 FIRE BRIGADE INLET CONNECTION (FBIC)

FBIC shall be as per IS 5131 & gunmetal four away connecting head with 4 x 63 mm dia instantaneous type inlets with built in check valve and 150mm dia outlet connection to the fire main grid with 150mm dia Butterfly valve and non – return valve.

2.9 AIR RELEASE VALVES

Air release valve is 20mm screwed inlet GM single acting type and shall be fixed on all high points in the system or as shown on drawings.

2.10 DRAIN VALVES

Gun metal Gate / Ball valve of 25 / 40 / 50mm dia as per IS;778 with GI pipe conforming to IS 1239 heavy class for draining any water in the system / Risers in low points

2.11 VALVE CHAMBERS

Contractor shall provide suitable brick masonry chambers in cement mortar 1:5 (1 cement : 5 Coarse sand) on cement concrete foundations 150mm thick 1:5:10 mix (1 cement : 5 fine sand : 10 graded stone aggregate 20mm nominal size) 15mm thick cement plaster inside and outside finished with a floating coat of neat cement inside with DI Heavy Duty top cover with frame etc.) approved by local fire brigade including excavation, back filling and additional Iron rungs for entering in to valve chamber etc., complete.

2.12 PIPE PROTECTION – ABOVE GROUND PIPES

All pipes above ground and in exposed locations shall be painted with two coats of Zinc rich primer and two or more coats (each of 75 microns) of synthetic enamel paint of approved shade. The pipes should be initially brushed to remove all foreign matter before applying paint / primer.

PIPE PROTECTION – UNDER GROUND METAL PIPES

The pipes (buried) should be initially brushed to remove all foreign matter and apply the primer over the pipe. Primer is allowed to dry until the solvent evaporates and surface becomes tacky. The tape 4mm thick and 150/250mm wide shall then be wound in a spiral fashion and bonded completely to pipe by thermo fusion process. The overlap is to be maintained at 15mm.

2.13 TESTS AT SITE

PIPING

All piping in the system shall be tested to hydrostatic pressure of 1. 5 times of the working pressure without drop in pressure for at least 8-10 Hrs. The test should be made in the presence of and to the satisfaction of the Employers representatives. Any defects / leakage should be repaired or if necessary defective works / equipment should be replaced with new work / equipment. Tests should be repeated until work is done to the satisfaction of concern representatives.

After testing all pipes shall be flushed with portable water to remove foreign materials. Underground Pipes after lowered in to trenches shall be Holiday tested for damages of the anticorrosion treatment and damages should be rectified, bring it to the notice of the engineer – in –charge of site before closing the trenches.

3 PUMPS

On completion of installation works at site the complete system shall be tested for satisfactory performance in line with specifications as per Tender / requirements of Employer. Pumps should test for Sequential Auto start in case of using the Hydrants / sprinklers / on actuation of HVWS system. Also, pump shall deliver minimum required flow & pressure at top most hydrant point. All instruments for testing should be arranged by the Contractor. The performance test includes commissioning spares like, diesel oil, engine oil, coolant, grease, gland packs and spare refills for Fire extinguishers etc. complete.

PUMPS AND ACCESSORIES

The pumps shall be exclusively used for firefighting purposes and shall be BIS approved as mentioned in the BOQ. One set for each system with electrical motor driven direct couple centrifugal pump of adequate discharge and additional common standby Diesel engine driven direct coupled centrifugal pump of adequate discharge and head shall be provided. The pumping capacity of main and stand by hydrant / Sprinkler system pumps shall be as mentioned in the BOQ.

GENERAL REQUIREMENT

The pumps shall be centrifugal type, pump designed for continuous operation and shall have a continuously dropping head characteristic without any zone of instability. The power capacity characteristic shall be non-over loading type. The head vs. capacity, input power vs. capacity characteristics, etc., shall match to ensure load sharing and

trouble-free operation throughout the range. 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. The contractor under this specification shall assume full responsibility in the operation of the pump and the drive as one unit. The pump shall be capable to discharge 150 percent of rated capacity at a total head of not less than 65 percent of the total rated head. The total shut off head shall not exceed 120 percent of total rated head on the pump. An 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.

This valve shall be located at the highest point in the discharge line between the pump and the discharge check valve. Pump coupled with motor or engine on a common base plate shall perform smoothly without any excessive noise or vibration. Also, pump shall be provided with re-circulation piping with valves.

PUMP CASING

The casing shall be cast iron to IS 210 and capable of withstanding to the maximum pressure developed by the pump at the pumping temperature.

IMPELLER

The impeller shall be of standard bronze. The impeller shall be secured to the shaft with hydraulically balanced and shall be retained against circumferential movement by keying, pinning or lock rings. All screwed fasteners shall tighten in the direction of normal rotation.

SHAFT

Shaft size shall be selected on the basis of maximum combined shear stress. The shaft shall be of stainless steel AISI-410 ground and polished to final dimensions and shall be adequately sized to withstand all stresses from motor weight, hydraulic loads, vibrations and torque's coming in during operation. Pump Shaft-Motor Shaft Coupling shall be connected with adequately sized flexible couplings with spacer of suitable approved design. Necessary guards shall be provided for couplings. Pump shall be consisting with Gland plate for gland packing.

BASE PLATE

A common base plate for mounting both the pump and drive shall be provided. The base plate shall be of rigid construction, shall be fabricated by M.S. channels. Base plate and pump support shall be so constructed, the pumping unit shall be mounted so as to minimize misalignment caused by mechanical forces such as normal piping strain, hydraulic piping thrust etc.,

VIBRATION AND BALANCING

The rotating elements shall be so designed to ensure least vibration during start and throughout the operation of the equipment. All rotating components shall be statically and dynamically balanced at workshop. All the components of pumps of identical parameters supplied under these specifications shall be interchangeable.

INSTRUCTION MANUAL AND TOOLS/SPARES

A comprehensive instruction manual shall be provided by the sub-contractor indicating detailed requirements for operation, dismantling and periodic operation and maintenance procedures. Recommended tools/spares shall be provided along with the Pump set.

4 DIESEL ENGINE

GENERAL

The diesel engine shall be of multi cylinder type four-stroke cycle with mechanical (airless) injection, cold starting type. The engine shall be manufactured as per IS 10000 and shall be ease of maintenance, repair, cleaning and inspection. This will also provide interchangeability of parts. All parts susceptible to temperature changes shall have tolerance for expansion and contraction without resulting in leakage, misalignment of parts or injury to parts.

STARTING

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. Engine shall be able to start without any preliminary heating of combustion chamber; cranking mechanism shall also be provided. All controls/ mechanism, which has to be operated in the starting process, shall be within easy reach of the operator. A DC motor charged by battery shall initiate automatic start of diesel engine. The battery shall hold adequate retainable charge to provide the starting of the diesel engine. Starting power will be supplied from two sets of storage batteries. One set of battery is for automatic starting of the engine and the other provided for manual starting. A selector switch will be provided at automatic starting control panel to select any of the two sets of battery for manual / auto starting of the engine. The battery capacity shall be adequate for ten consecutive starts without recharging with a cold engine under full compression. The battery banks shall be used for no other purpose other than starting of the engine and shall be fully charged at all times with provision for trickle and boost charges. After start of the engine the charger shall be disconnected, the battery being fed from the engine dynamo. The two-battery charger of air-cooled type shall be able to charge on battery bank at a time. The D/E starting panel along with the battery chargers should be of reputed approved makes.

GOVERNING SYSTEM

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. The Governor shall offer following features: An 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.

FUEL SYSTEM

The diesel engine is to run on high-speed diesel, the tank provided being enough to hold the volume required for 8 hours (minimum) engine run time+ 5% for expansion+5% for volume of fire tank. Fuel tank shall be double wall type and to be containment, so that over flow of the fuel shall be collected in the secondary tank. Fuel supply and return piping shall be metal with necessary valves. Fuel tank shall be mounted on the fabricated consisting with

air vent, over flow, drain, filling and manhole etc. It shall also be provided with the magnetic level switch which shall be connected to Electrical panel.

COOLING WATER SYSTEM

Direct cooling system shall be employed for the diesel engine. Water shall be tapped from the fire pump discharge. This water shall be led through duplex strainer, pressure breakdown orifice and then after passing through the engine, the outlet water shall be taken directly to the sump through an elevated funnel. Re-circulating thermo siphon system of cooling using a fan cooled radiator or indirect cooling system using heat exchanger shall not be accepted.

ACCESSORIES

The engine shall be mounted on a base plate of fabricated steel construction. Adequate access shall be provided for the big end and main bearings, camshaft and governor drives, water jackets etc. The engine shall have a base plate made from MS sections. There shall be reasonable space at the big end, camshaft, water jackets, governor drives and main bearings. The engine shall be provided with intake and discharge ductwork, inlet filter and silencer, outlet muffler, expansion joints, dampers etc., as necessary for efficient operation. Intake air should be taken from inside the building in which the engine is located, but the exhaust should be discharged outside the building and exhaust duct shall be adequately sized for minimum pressure drop as per relevant code/standard, and shall be housed clearing man height. The flywheel shall have graduated marking around the periphery to facilitate checking of valve and fuel pump timings. Full set of diesel engine spares as per Standard requirement to be provided along with tool kit.

INSTRUMENTATION

The diesel engine shall be provided with adequate instrumentation. The gauges etc., as required are provided for in the Engine Panel. Also, Bidder shall supply one set of Spare parts recommended by the manufacturer for maintenance purposes.

5 AUTOMATIC SRINKLER SYSTEM

SCOPE OF WORK

The sprinkler system shall be provided in basement and all upper floors. This system shall include the following:

Sprinkler main, branch and internal piping complete with valves, alarms and supporting arrangements. Sprinkler heads with spare sprinklers. Connections to risers etc., all material shall be of the best quality conforming to specifications and subject to the approval of the Engineer-in-Charge. Pipes and fittings shall be fixed truly vertical/horizontal or on slopes required in a neat manner. Pipes shall be fixed in such a manner so as to provide easy accessibility for repair and maintenance and shall not cause obstruction in shafts, passages etc., Pipes shall be securely fixed to walls and ceilings by suitable clamps at intervals specified. Only approved types of anchor fasteners shall be used for RCC ceilings and walls. Valves and other equipment shall be so located that they are easily accessible for operation, repairs and maintenance.

SPRINKLER HEADS

The sprinkler heads shall be UL listed fixed temperature quick release type with a quartzoid bulb containing liquid having high vapor pressure held in position by a forged GM

yoke and deflector. The rated temperature of quartzoid bulb shall be based on requirements. The spacing shall however conform to the detailed drawing, in Co-ordination with electrical and other allied services at the ceiling level. Sub-contractor shall supply spare sprinkler heads and spanners neatly installed in a steel box with glass shutter at an appropriate position approved by the Engineer-in-Charge.

A water motor gong and an inspection test connection shall be provided on the down streamside of the system.

Sprinklers for below false ceiling shall be fixed with recessed (two piece) type Rosette plate fabricated by S.S. sheet of 2mm thick. Also note sprinklers for below false ceiling shall be dropped by using flexi pipes of approved make & size and length. Contractor should note the location of window sprinklers provided on the periphery of the office areas and ground floor. The spacing and mounting should be as per the manufacturer's recommendations to provide protection to the façade glass.

PIPES AND FITTINGS

Pipes for the sprinkler system shall refer to the clause No. 2.2 - above.

6 ELECTRICAL WORKS

General

The CONTRACTOR shall supply and install the electrical equipment and services necessary for the efficient and safe operation of the fire protection systems detailed elsewhere in the specification, including :-

(a) Motors for Fire water pumps.

(b) MCC cum control panel housing the starters for all motors and complete with the switches, relays, push buttons, indicating lamps, etc. necessary for the control of the fire protection system

(c) Power and control cabling between the MCC, motors, pressure switches, etc. including accessories like conduits, cable trays ,etc.,

(d) To carry out the electrical installation works in accordance with specifications and as required by the local statutory departments.

(e) To include the preparation of shop drawings and construction drawings for submission to the Consulting Engineers to review prior to construction. Final as-built drawings after commissioning of the Fire Protection System.

ELECTRIC MOTORS

The motor shall be as per IS: 325 and with class "F" insulation, totally enclosed fan cooled, horizontal induction foot mounted type and rated not to draw starting current more than 6 times normal running current. Motor shall be capable of driving the pumps at rated discharge and head & at 150% of its rated discharge at 65 % of the rated head (in any case 15 % safety load should add) and shall be designed for continuous full load duty. The motor shall be capable of handling the required starting torque of the pumps. Speed of motor shall be compatible with the speed of the pump. The cooling fans shall be directly driven from motor shaft. Motor situated outdoors or exposed to the weather shall be weather protected. Motors shall be enclosed type and shall have dust tight construction with suitable means of breathing and of drainage to prevent accumulation of water from condensation. Drain holes shall exclude bodies greater than 6mm diameter.

BIT

All components shall be of adequate mechanical strength and robustness and shall be constructed of metal unless otherwise approved. All motors shall be dynamically balanced.

The enclosure shall be designed to provide an effective sealing between the primary and secondary air circuits. Motor winding shall be vacuum impregnated with heat and moisture resistant varnish glass fiber insulated. Two independent earthing points shall be provided in accordance with IS: 3043 on opposite sides of the motor for bolted connection. The cable boxes and termination shall be designed to enable easy disconnection and replacement of cables.

STORING, LAYING, JOINTING AND TERMINATIONS

STORING

On receipt of cables at site the cables shall be inspected and stored in a safe place.

LAYING

Cables shall be laid as per the specifications given below.

CABLES IN OUTDOOR TRENCHES

Cables shall be laid in outdoor trenches wherever called for. The depth of the trenches shall not be less than 75 cm from the final ground level. The width of the trenches shall suit easy laying of cable. Where more than one cable has to be laid in the same trench, all attempts shall be made to keep the axial distance between successive cables to be at least 1d where'd' is the diameter of the bigger cable. The trenches shall be cut square with vertical side walls and with uniform depth. Wherever cables are bent, the minimum bending radius shall not be less than 12 times the diameter of the cable. After the cable is laid and straightened, it shall be covered with minimum 150mm deep sand cushion. Over this a course of cable protection tiles or burnt brick shall be provided on either side and above. A yellow market tape will be placed on top and then the trench shall be back filled with earth and consolidated. Cables shall be laid in Hume pipes at all road crossings & wall entries. A 200mm concrete cover shall be provided over all road crossing Hume pipes. Approved cable markers made of CI indicating the voltage, no. of cables and the direction of run of the cables shall be installed at 50m intervals and all changes in direction.

CABLE IN INDOOR TRENCHES

Cables shall be laid in indoor trenches wherever specified. Suitable angle iron brackets, clamps, hoods and saddles shall be used for securing the cable in position.

CABLE ON TRAYS/RACKS

Cables shall be laid on cable trays/racks wherever specified. Cable racks/trays shall be of perforated steel section/slotted angles suitable for the purpose. The trays/racks shall be complete with plates, tees, elbows, risers and all necessary hardware. The steel trays shall be hot dip galvanized. Cable trays shall be erected properly to present a neat and clean appearance. Suitable cleats or saddles shall be used for securing the cables to the cable trays. The cable trays shall comply with the following requirements

The trays are ladder type and shall have suitable strength and rigidity to provide adequate support for all contained cables. It shall not present sharp edges, burrs of projections injurious to the insulation of the wiring/cables. If made of Sheet metal, it shall be adequately protected against corrosion or shall be made of corrosion resistant material. It shall have side rails or equivalent structural members. It shall include fittings such as horizontal, vertical bends, tie rods, hooks etc., or other suitable means for changes in direction and elevation of runs, fish plates and hard ware.

INSTALLATION

BIT

Cable trays shall be installed as a complete system. Trays shall be supported properly from the building structure. The entire cable tray system shall be rigid. Each run of the cable tray shall be completed before the installation of cables. In-portions where additional protection is required, non-combustible covers/enclosure shall be used. Cable trays shall be exposed and accessible. Where cables of different system are installed on the same cable tray, non-combustible solid barriers shall be used for segregating the cables. Cable trays shall be grounded by two nos. Earth continuity wires. Cable trays shall not be used as equipment grounding conductors.

JOINTING AND TERMINATIONS

Cable jointing shall be done as per the recommendations of the cable manufacturer. Jointing shall be done by qualified cable jointers. Each termination shall be carried out using brass compression glands and cable sockets. Hydraulic crimping tool shall be used for making the end terminations. Cable gland shall be bonded to the earth by suing suitable size G.I. wire/tape.

Suitable identification tags with the feeder designation inscribed on an aluminum/G.I. sheet shall be tied to either ends of each cable.

TESTING

Cables shall be tested at factory as per the requirements of IS 1554 Part I. The tests shall incorporate routine tests, type tests and acceptance tests. Copy of such test certificates shall be furnished to the Employer prior to dispatch.

7 FIRE EXTINGUISHERS

Fire extinguishers shall be worked out in such a way that the Occupants shall not travel more than 22.5m to reach a Fire extinguisher. Also, there shall be a Fire extinguisher for every 500 sq.m of floor plate / rooms of suitable type / size. Additional to Office areas Extinguishers to be provided at Surface car parks, outdoor Transformers / electrical instillations and on the landing of each Staircase of all floors.

All Fire extinguishers shall be portable and hand held, an operating instruction should be pasted on the extinguisher body.

Portable Fire extinguishers should be BIS approved and valid ISI certificates to be furnished at the time of delivery to site.

8.SIGNAGE

Required, as per Local fire force like exit signs & Floor indication (e.g. Ground floor, 1st floor...), size shall 200mm x 500mm & action chart (size shall be 600mm x 1000mm) in case of fire / emergency, Staircase location indication etc. The location / quantity shall be on each landing of every staircase on each floor.

Signs shall be made out of 3mm thick PVC foam board with PVC non – reflective self-adhesive Vinyl foam board OR equivalent material with Mirror fasteners for fixing complete.

Please refer the specimen BOQ format for the details to be printed on the Fire order boards.

BIT

TECHNICAL DATA SHEEETS

(Note: Bidder should fill Blanks)

DATA SHEET FOR DIESEL ENGINE PUMP		
DESCRIPTION		
Service	Fire Fighting	
	As per Tender	As offered
Type		
Manufacturer		
Model No. / Approval	BIS	
Quantity	As per BOQ	
Duty		
Design and Performance		
Number of cylinders, orientation of cylinder, bore and		
stroke (in mm)		
Direction of Rotation	Anti-Clock wise from the fly wheel side	
Rated R.P.M	1800 RPM	
Brake horse power rating of engine at rated RPM		
Lube oil temperature		
Lube oil pressure at rated load		
Fuel oil pressure		
Blow type pressure		
Exhaust Temperature		
Water temperature		
Lube oil consumption		
Permanent Governing	10% of rated speed	
Oil Lubrication System		
Material and wire mesh size of filters	Paper type 40 microns	
Whether pumps are crank driven		
Capacity and location of reservoirs		
Whether all valves, piping and fittings		
Whether cooling arrangement for oil lubrication system		
provided		
Cooling water inlet temp. to cooler (temp gauge)		
Cooling water outlet temp. from cooler (temp gauge)		
Cooling (Raw) water flow		
Design pressure		
Governing System		
Whether speed governing system provided	Yes	
Make		

BIT

Type	Mechanical	
Steady state speed	1800 RPM	
Steady state incremental speed regulation	10% of rated speed	
High water temperature alarm switch provided as per specification		
	Yes, Provided	
Self-stating system	Yes, Electrical.	
Voltage and capacity	24 V	
Starting motor - make and type		
Battery - make and type		
Battery - No. per engine	2 Nos.	
Time required by the engine to accept fill load after receipt of the signal to start from cold condition	15 seconds	
Alternative manual starting arrangement provided	Yes, through electric starter motor	
Lubrication oil pr. Gauge	Yes	
Make & type		
No. per engine	One	
Range		
Location	Panel	
Accuracy	5%	
Thermometer for coolant temperature measurement		
(capillary type)	One	
Make & type		
No. per engine	One	
Location	0 to 110 ^{0}c	
Accuracy	5%	
Techo-meter for Engine RPM measurement	Yes	
Make & type		
No. per engine	One	
Location	0 - 2000 RPM	
Accuracy	5%	
Battery charging system	Yes	
Make		
Type	Alternator	
No. per engine	One	
Rectifier type battery charger		
Type of semiconductor		
Supply voltage, phase and frequency	230 V Single Phase 50 Hz	
Delivery current rating	10 Amps	
Voltmeter details		
Make		

Nos. per engine	1 No.	
Range	0 – 50 V DC	
Dial size. mm	100 mm dia.	
Ammeter details		
Make		
Nos. per engine	One	
Range	0+/- 30 A DC	
Dial size. mm	52 mm	
Fuel System		
Gravity tank details		
No. (for each engine)	1 No.	
Whether integral with engine	Separately mounted	
Capacity, liters		
Material	MS sheet fabricated	
Engine fuel pump supplied	Yes	
All pipes, valves, fittings, filter etc. supplied	Yes	
Cooling system		
Direct cooling system provided		
Necessary piping, fittings, valves, Pr. Reducing orifice,		
pressure gauges, duplex strainer etc. furnished	Yes	
Cooling water requirement		
Cooling water pressure		
Cooling water inlet temperature before cooling		
Cooling water outlet temp. after cooling		
Heat exchanger type		
Alternative engine mounted air-cooled radiator for cooling	- NA -	
system, if offered of the bidder		
a) Type		
b) Make		
c) Location		
d) Water inlet temp.		
e) Water outlet temp.		
f) Cooling air flow		
g) Total cooling surface area		
h) Material of construction (Indicate applicable codes/		
standards)		
i) Tubes		
ii) fins		
iii)Header		

Cooling system		
a) Type		
b) Number		
c) Location		
d) Capacity of each fan		
e) Power required at fan at rated condition of the engine.		
f) fan speed		
h) Material of construction (Indicate applicable codes/		
standards)		
i) Blade		
ii) Shaft		
Whether provision made for by-passing radiator		
system to avoid chilling of engine		
Temperature indicator in Lubricating oil outlet from	Indicator provided on	
the oil cooler	oil pan.	
Make and type		
Nos. per engine	One	
Range		
Location	On instrument panel.	
Throttle Mechanism		
Whether throttle mechanism provided	Yes	
Type	Vernier Throttle control	
Number per engine	One	
Engine Protection		
Type of engine protection provided	Safety controls bring provisions for	
	high water temp and low lube oil PR.	
Flywheel with guard provided	Yes	
Material of construction		
Fly wheel	CI	
Guard for flywheel	CI	
Material of construction of the various parts of the engine		
Base plate	MS Channel	
Foundation bolts	MS	
Crankcase integral with cylinder block	CI	
Cylinder head	CI	
Cylinder liner	Spheroidal graphite iron	
Crank Shaft	Forged steel	
Connecting rods	Forged Steel	
Engine block	Alloy Cast Iron	

BIT

Piston	Aluminum alloy	
Cam Shaft	Forged steel	
Piston ring	Steel	
Inlet and exhaust valves	Special heat-resistant steel valve and valve heads are Stellite faced	
Valve gear	Steel	
Painting		
Primer	Two coats of Red Oxide primer	
Finish paint	Fire Red color.	
Weight of the engine (dry)		
Pump approval	BIS	
Inspection and Testing	Witness at Manufacturers place in presence of clients representative	

DATA SHEET FOR ELECTRIC DRIVEN PUMP		
DESCRIPTION	Fire Fighting	
General		
Project / System		
Manufacturer		
Type		
Model No		
No. of Pumps offered	As per BOQ	
Equipment Performance		
Performance Standard		
Guaranteed Design capacity (LPM)	2850	
Guaranteed total head at discharge flange at rated capacity (MLC) with respect to MWL as specified in Data Sheets		
Shut off Head (MLC)		
Range of operation within which the pump can operate Continuously without any problem		
Pump rated speed (RPM) (Normal design speed)		
Guaranteed pump efficiency at rated capacity (%) with HIS tolerance		
The Pumps offered have stable rising H-Q		
curves characteristics from the specified duty	Yes	
point to the Shut-off. The pump should be capable of giving up to 150% of its rated flow at not less than 65% head as per NFPA.		

The pumps offered have stable rising H-Q		
curves characteristics through the Range of	Yes	
Operation		
Expected noise level		
Expected vibration limit	As per standard	
Power Consumption		
Guaranteed pump Shaft input power at rated		
capacity (KW)		
Maximum pump Shaft input power required at		
rated condition motor terminal(input power at		
specified capacity and head of pump)		
Shaft input power at pump Shut off		
Pump Shaft input power required during starting		
Power consumption at 150% of rated capacity at		
motor terminals		
Total head at discharge flange at 150% rated		
capacity (MLC) with respect to Minimum water		
level (MWL)		
Motor Rating (KW)		
Design and Constructional Features		
Pump Duty	Continuous	
Pump Type		
Pump Design		
Impeller Type	Enclosed	
Number of stages		
Moment of Inertia GD2 of the complete rotating		
system including pump (Kg. Sq.m)		
Whether the pumps offered can be started with		
discharge valve closed		
What precautionary measures is required to		
be taken to action on the valve disc. if the pump		
started with valve fully closed		
Type and make of coupling	Spacer	
between pump and drive		
Lubricant specification for external lubrication		

(stuffing box) self-lubrication for pump		
Manufacturer's Catalogue No.	To be Enclosed	
Design axial load (kg) (at duty point)		
Material of Construction		
Base Plate	As per Manufacturer	
Impeller	Bronze to IS 318 Gr. 2	
Impeller shaft	AISI-410	
Impeller wear rings	CI to IS:210 Gr. 260	
Casing wear rings	CI to IS:210 Gr. 260	
shaft Sleeve	AISI 410	
shaft Coupling	AISI 410	
Stuffing box	CI - IS:210 Gr. 260	
Stuffing box packing	PTFE Filled	
Casing bowl	CI as per IS 210 Gr. FG 260	
Connections and other dimensional details		
Discharge nozzle diameter		
Flange drilling standard		
and pressure rating	ANSI B 16 .5 #150	
Rated RPM		
Inspection & Testing		
Material Test	Yes	
Hydrostatic test Pr. and duration (min)		
Performance Test	Witness at Manufacturers place in presence of client's representative	
Testing standard	As per IS : 9137	
Test to be conducted on		
Loading Data	GA drawing	
Weight Data		
Pumps approval	BIS	

BIT

DATA SHEET FOR JOCKEY PUMP		
	As per Tender	As offered
Manufacturer		
Type		
Model No.		
Duty		
Location		
No. of Pumps required	As per BOQ	
No. of Pumps working		
No. of Pumps Standby	NIL	
No. of Pumps working in parallel		
Pump Performance		
Performance standard	IS:5120	
Rated Capacity		
Total Dynamic Head (MWC)		
At rated capacity		
At Shut off		
Rated Speed		
Noise level in 'dbA' at a distance of 1.5 m from		
the pump centre line		
Pump Input Power at drive end (KW)		
At rated duty point		
Maximum Pump Shaft input power required within		
the working range of the pump		
Motor rating (KW)		
Permissible tolerance in rated capacity (%)		
Permissible tolerance in efficiency at rated		
capacity (%)+_2.5%		
Range of operation		
Min./Max. capacity at which pump can operate		
continuously		
Direction of Rotation (VFCE)	Clock wise from Drive end	
Design standard	IS 9137	
Pump type		
Impeller type	Enclosed	
Type of gland lubrication & sealing		
Type of pump motor connection	Direct coupling	
Type of coupling	Love joy spacer type	
Material of Construction		

Impeller	Bronze to IS 318 Gr 2	
Wearing rings (casing / impeller)	Bronze	
Shaft Sleeve	AISI 410	
Shaft bearings	Steel	
Base plate	MS fabricated	
Stuffing box	CI-IS 210, GR. 260	
Stuffing box packing	Gland packing	
Pump Shaft	AISI - 410	
Casing bowl	CI - IS:210 Gr. 260	
Shaft coupling	AISI 410	
Discharge head		
Companion flange	Carbon steel (IS:2062)	
Supply of accessories		
Base Plate	Yes	
Foundation bolts, nuts, etc.	Yes	
Discharge companion flanges with bolts, nuts		
and gaskets		
Painting and protective coating	Yes	
Inspection and Testing	Witness at Manufacturers place in presence of clients representative	

BIT

DATA SHEET FOR SPRINKLER BULB		
	As per Tender	As offered
Name of manufacturer / Approval	UL/FM	
Type	Pendent / Upright	
Design Particulars		
End connection	½ inch BSPT	
Operating Temperature	68 / 141 Deg. C	
Colour coding of bulb	Red	
K factor	80	
Material of construction		
Housing	Forged Brass	
Glass bulb	Quartzoid bulb	
Deflector	Brass	
Painting		
finish	Nickel Chrome Plated	
Testing and Inspection		
Visual	100%	
Marking on equipment		
Manufacture's name	Yes	
Year of manufacture	Yes	
Operating temperature	Yes	

BIT

DATA SHEET FOR FIRE HOSES		
	As per Tender	As offered
Manufacturer		
Type	RRL	
Code	IS:636 Type A	
Size & Length	63 mm dia.15m.	
Working pressure		
Test pressure	21.4 bar	
Burst Pressure	Exceeds 35.7 bar. (Shall withstand	
	working pressure of 8.5 bar without leakage)	
Weight gm/m	1 Kg/m	
General Construction	As per IS 636	
End fittings (quick coupling end)	GM heavy quality spring lock type	
	coupling as per IS:903	
Material of Construction		
Hoses	RRL	
Quick coupling	Gun Metal	
Approval		
Testing and Inspection	TC's of manufacturer Shall be produced.	
Catalogues		

BIT

DATA SHEET FOR ALARM VALVES		
	As per Tender	As offered
Name of manufacturer		
Model / Approval		
Size	NB 80 to NB 200 NB	
Type	Double seated clapper check	
	sprinkler valve with grooved seat	
	Design and variable pressure.	
Design Particulars		
Inlet flange	Equivalent to valve size	
Outlet flange	Equivalent to valve size	
Flange dimensions	ASNI B16.5 flate face class 150 FF	
Friction loss (Eqiu. Length Pipe)	a. 80 NB :	
	b. 100 NB :	
	c. 150 NB :	
Max. Working Pressure		
Hydro test pressure	25 Kg/sq.cm (for 5 minutes)	
Approval		
'**UL**' listed	Yes	
Material of construction		
Housing	C.I. IS:210 GR.FG.260	
Clapper / clapper bush	Bronze IS:318 LTB II	
Rubber clamp	Bronze IS:318 LTB II	
Body bush	Bronze IS:318 LTB II	
Seat Rubber	Neoprene	

BIT

ACCESSORIES FOR ALARM VALVES		
	As per Tender	As offered
Water motor gong bell	Yes	
Wet pilot trim	Yes	
Test & Alarm trim	Yes	
Painting		
Primer	Zinc Chromate - 2 coats	
finish	Red enamel paint - 2 coats	
Testing and inspection		
Visual	1	
Hydro test pressure	25 Kg/sq.cm	
Marking on equipment		
Manufacture's name	Yes	
Year of manufacture	Yes	
Serial No.	Yes	
Size	Yes	
Rated Pressure	Yes	
Documents to be submitted for inspection		
Test Certificate		
Material test certificate		
Guarantee Certificate		

HYDRANT VALVES		
Manufacturer / Approval	As per Tender	As offered
Size / Model	63 mm	
Type	Oblique	
Spring / washer	Phosphor wire-IS : 7608/ Rubber-IS : 937	
Material of construction	Gun-metal -As Per IS : 318 GR. LTB2	
Body	Gun-metal -As Per IS : 318 GR. LTB2	
Bonet	Gun-metal -As Per IS : 318 GR. LTB2	
Stop vale	Gun-metal -As Per IS : 318 GR. LTB2	
Instantaneous Female outlet	Gun-metal -As Per IS : 318 GR. LTB2	
Blank Cap	Gun-metal -As Per IS : 318 GR. LTB2	
Hand wheel	CI Confirming to IS : 210	

Spindle	Brass Confirming to IS : 319	
Document for approval	-	
Testing / inspection	Manufacturers test certificates	

DATA SHEET FOR GATE VALVES		
Manufacturer		
	As per Tender	As offered
Size	50 mm to 450 mm dia.	
Type	Rising spindle with monitoring/limit switch connected to BMS	
Code	IS:14846	
Pressure class	PN 20	
End connection	Flanged	
Material of construction		
Body	CI to IS:210 Gr.FG.260	
Bonnet	CI to IS:210 Gr.FG.260	
Wedge	CI to IS:210 Gr.FG.260	
Stuffing box	CI to IS:210 Gr.FG.260	
Gland	CI to IS;210 Gr.FG.260	
Hand wheel	CI to IS:210 Gr.FG.260	
Stem	High Tensile Brass	
Body seat ring	IS:318 LTB2	
Wedge seat ring	IS:318 LTB2	
Wedge nut	IS:318 LTB2	
Gasket	Rubber IS:638 Type B	
Gland pack	Jute & Hemp – IS:5414	
Thrust plate	CI to IS:210 Gr.FG.260	
Bolt and nuts	CS to IS:1367	
Test Pressure		
Body	24 bar	
Seat	16 bar	
Model of operation	Wheel operated	
Testing & Inspection		

BIT

DATA SHEET FOR NON RETURN VALVE		
Manufacturer		
	As per Tender	As offered
Type	Swing disc	
Code/ Standard	IS:5312	
Material of construction		
Body	CI IS 210 Gr. FG260	
Cover	CI IS 210 Gr. FG260	
Flap	CI IS 210 Gr. FG260	
Hinge Bracket	CI IS 210 Gr. FG260	
Body seat ring	IS:318 LTB2	
Flap seat ring	IS:318 LTB2	
Hinge Pin	IS:320 HT2	
Size	100 NB, 150 NB & 200 NB	
End connection	F.F.Flanged ANSI B 16.5-150#	
Max. System working Pressure	18 Kg/Cm^2	
Hydrostatic test pressure		
a) Body	24 Kg/ Cm^2	
b) Seat	16 Kg/ Cm^2	
Testing & Inspection		
Approval / Certification		

DATA SHEET FOR BUTTERFLY VALVES		
	As per Tender	As offered
Manufacturer		
Type	flow control lever/Gear operated, wafer type with limit switch/flow switch linked to BMS	
Code/ Standard	BS: 5155, PN 20,	
Material of construction		
Body	CI IS 210 Gr. FG 260	
Disc	DI to ASTM A 536 Gr. 0-40-18	
Shaft	SS 316	
Shaft Seal	Black Nitrile Rubber	
Control lever	S.G Iron	
Test Pressure	16 bar for Seat & 24bar for Body	
CATALOGUE		
Inspection & Testing		

DATA SHEET FOR PIPES		
	As per Tender	As offered
Manufacturer		

BIT

Standard	IS:1239 Pt – I up to 150 mm dia and	
	IS 3589 for above 200 mm dia	
Type	ERW	
Material	GI	
Class & Grade	Class C	
End type	Plain end	
Type of protective coating		
Under Ground	Anticorrosive treatment as per IS	
	10221	
Above Ground	Two coats of paint on coat of primer	
Testing Pressure	150 % of Working – Hydro test for	
	2Hrs.	
Working Pressure	8 Bar	
Inspection & Testing		
Welding Electrodes	Esab / Advani (7018 Grade)	
Type / make		

PIPE FITTINGS		
As per Tender		As offered
Manufacturer	UL listed	
Type	Butt Welded/ Socket fitting	
Code/ Standard	ANSI/AWWA	
Couplings	Flexible	
Bolts & Nuts	Galvanized	
Gaskets	3 mm Thick Rubber	

BIT

DATA SHEET FOR FIRE SHUTTER		
	As per Tender	As offered
Manufacturer		
Standard	Manufacturers Standard	
Material of Construction	Anodized Aluminum sheet of 2mm thick	
Finish	Powder coated both inside & out side	
Glass thickness	4 mm	
Size	900mm x 1200mm	
Color	Red	
Marking	" FIRE " letters of 80 mm size	
Locking arrangement	Built in lock	

DATA SHEET FOR FIRE BRIGADE INLET		
	As per Tender	As per Vendor
Manufacturer		
Standard	IS 5131	
Material of Construction		
Inlet	63 mm dia. male type GM coupling with	
	built in NRV	
Out let	Flanged as per ASA b 16.5, a50 class	
Spring	Phosphor Bronze to IS 7608	
Seat washer	Rubber IS 937	
Flange	IS 1538 (Flat face)	
Blackcap	Rubber IS 937	
Hydro test pressure	21 Kg / sq.cm	
Mounting		

BIT

DATA SHEET FOR BRANCH PIPE WITH NOZZLE		
	As per Tender	As offered
Manufacturer		
Standard		
Branch pipe	IS 903	
Nozzle	IS 903	
Material of construction		
Branch pipe	Gun metal, IS 318 LTB 2	
Nozzle	Gun metal, IS 318 LTB 2	
Coupling	Gun metal, IS 318 LTB 2	
Size		
Branch pipe	63MM	
Nozzle	19MM	
Hydro test pressure	21 Kg / sq.cm	
Flow	900LPM at 12 bar	

DATA SHEET FOR HOSE CABINET		
	As per Tender	As offered
Manufacturer		
Standard	Manufacturers Standard	
Material of Construction	M.S. Sheet of 16 SWG	
Finish	Powder coated both inside & out side	
Glass thickness	4 mm	
Size	750 mm x 600mm x 250mm	
Colour	Red OR as approved by clients	
Marking	" FIRE " letters of 80 mm size, on both doors	
Locking arrangement	Built in lock (Glass break type)	
Type	Wall mounted for internal and	
	Stand mounted for External	

BIT

DATA SHEET FOR HOSE REEL		
	As per Tender	As offered
Manufacturer		
Standard	Manufacturers Standard	
Type		
Material of Construction		
Drum	M.S. Sheet of 16 SWG	
Base plate		
Bearing	Brass / GM	
Hose	Braided Rubber	
Finish	Powder coated both inside & out side	
Size	520 dia. and 250 width	
Colour	Red OR as approved by clients	
Marking	" FIRE " letters of 80 mm size, on	
	both doors	
Accessories	Spray Nozzle, Gate valve,	
Anchor bolts, Hose clamps		
Hose length and dia	30 m , 19 mm dia	

DATA SHEET FOR PRESSURE SWITCH		
	As per Tender	As offered
Manufacturer		
Type of Mounting		
Material of Construction		
Casing & Body	Die cast Aluminum	
Sensing Element	Phosphor Bronze Bellows	
Enclosure		
Type of contact	micro switch snap action	
No. of Contacts	NO / NC – One each	
Size of Process connection	3/8" BSP	
Pressure Setting	At site	
Max. over Pressure	65 kg / sq.cm	
Adjustment	0.7 to 18 kg / sq.cm	

DATA SHEET FOR PRESSURE GUAGE		
	As per Tender	As offered
Manufacturer / Standard		
Type	Bourden	
Range	Available pressure X1.5	
Accuracy	+ / - 1 % of range span	

BIT

Size of Dial	150 mm dia	
Dial Material & Colour		
Window	Clear glass	
Material of Construction		
Enclosure	Die cast Aluminum, stove enameled Black	
Movement, Shank, Burdon	AISI SS 316	
Connection size	½" NPT (male)	
Mounting & Entry	Direct mounting, Bottom entry	
Cock	Gunmetal	
Siphon tube	SS 'U' type	

DATA SHEET FOR FIRE EXTINGUIHSERS		
CO2 type		
	As per Tender	As offered
Manufacturer		
Type	ABC POWDER TYPE 5KG/2KG	
Standard		
Size		
Diameter		
Height		
Weight		
Quantity		

BIT

DCP type		
	As per Tender	As offered
Manufacturer		
Type	DCP 5 Kgs	
Standard		
Size		
Diameter		
Height		
Weight		
Quantity		

DATA SHEET FOR FLEXIBLE DROP		
	As per Tender	As offered
General		
Project / System		
Manufacturer		
Type		
Model No		
Material		
Size		
Length		
Maximum working pressure		
Hydraulic test pressure		
Approvals		
Testing and Inspection		
Visual		
Marking on equipment		
Manufacture's name		

BIT

DATA SHEET FOR STRAINER		
	As per Tender	As offered
Project / System		
Manufacturer		
Type	Y type	
Model No		
Material: Body	CI	
Material: Mesh and no. of mesh	Brass/Bronze/SS – 100mesh	
Size		
Length		
Maximum working pressure	18 bar	
Hydraulic test pressure	25 bar	
Approvals		
Testing and Inspection		
Marking on equipment		

DATA SHEET FOR BALL VALVE		
General	As per Tender	As offered
Project / System		
Manufacturer		
Type		
Model No		
Material :Body	Brass	
Material of ball:	SS	
Disc packing	Teflon	
Size		
End Type	Screwed	
Type of threads	BSP T	
Maximum working pressure	18bar	
Hydraulic test pressure	25bar	
Approvals		
Testing and Inspection		

DATA SHEET FOR AIR RELEASE VALVE		
General	As per Tender	As offered
Project / System		
Manufacturer		
Type	Spring operated	
Model No		
Material :Body and Cap	Gun Metal	

washer	Rubber	
End Type	BSP T	
Maximum working pressure	18bar	
Hydraulic test pressure	25 bar	
Approvals		
Testing and Inspection		

DATA SHEET FOR AIR VESSEL		
General	As per Tender	As offered
Project / System		
Manufacturer		
Type		
Model No		
Material :	Epoxy coated steel	
Tank size	500L	
Diaphragm material	Neoprene	
Liquid Temp	40 Deg C	
Maximum working pressure	18 bar	
Hydraulic test pressure	25bar	
Approvals		
Testing and Inspection		

DATA SHEET FOR CABLES		
General	As per Tender	As offered
Project / System		
Manufacturer		
Conductor Type		
Insulation type	Flame retardant	
IS Standard	IS: 1554(Part 1&II)	
Core Identification		
3.5 core	Red, yellow, blue, Black	
4.0 Core	Red, yellow, blue, Black	
2 core	Red, Black	
Laboratory Tests		
a) Smoke density measurement test	As per ASTM D-2843	
b) Oxygen Index test	As per ASTM D-2863	
c) HCL liberation test	As per IEC - 754	
d) Flammability Test of Outer Sheath	As per IEC – 332-1 and Class F3 of Swedish standard SS-424-1475	
e) Routine and Acceptance Test	As per IS.	

BIT

DATA SHEET FOR PRESSURE TRANSMITER PARAMETER		
PARAMETER	*SPECIFICATION*	
Qty.	As per Tender	As offered
Fluid	***Water***	
Location	***Outlet of sprinkler and Hydrant Header*** ***Outlet of Tapping of Hydrant and sprinkler riser, shall be compatible to link with BMS***	
Fluid State	***Liquid***	
Make		
Flow through chamber	***Provided***	
Measuring Range	***0 – 18 kg/cm2***	
Fluid Handled	***Water***	
Temperature of Fluid	***30C***	
Operating Pressure (bar)	***0-18 kg/cm2***	
Installation	***On Line***	
Application	***pH Measurement***	
pH Range	***0 – 14***	
Output	***4-20 mA***	
Power Supply	***24 V DC Loop powered***	
Installation	***Pipe Mounting Bracket***	
Enclosure		
Model		

7.4

TECHNICAL SPECIFICATION FOR
FIRE ALARM AND PUBLIC ADDRESS SYSTEM

BIT

Scope:

The scope of work under for this Tender shall include supply, installation, testing, commissioning, training & handing over of the Safety and Security Systems. The work under this system shall consist of Supply, installation, testing, training & handing over of all materials, equipment, hardware, software appliances and necessary labour to commission the said system, complete with all the required components strictly as per the enclosed tender specifications, design details. The scope also include the supply, installation & commissioning of any material or equipment including civil works that are not specifically mentioned in the specifications and design details but are required for successful commissioning of the project.

The Systems that are proposed for this project are:

1. Analog addressable fire alarm system
2. Public address system.
3. Talk back system.

Technical Specifications For ANALOG ADDRESSABLE FIRE ALARM SYSTEM

Scope:

The scope of work under this head shall include Supply and installation of Fire Alarm System. The work under this system shall consist of supply, installation, testing, training & handing over of all materials, equipment's and appliances and labour necessary to commission the said system, complete with Smoke Sensors, Main Control Panel, Repeater Panel, Sounders, Manual Pull Stations, Modules, relays etc. for interfacing with other systems. It shall also include laying of cabling , necessary for installation of the system as indicated in the specification and Bill of Quantities. Any openings/chasing in the wall/ceiling required to be made for the installation shall be made good in appropriate manner.

Standards

The System design shall meet the following design Standards as required by IS 2189
Underwriters Laboratories Inc. (UL) - USA:

- NFPA 70 - 2002 National Electric Code®
- NFPA 72 - 1999 National Fire Alarm Code®
- NFPA 90A - 1999 Air Conditioning Systems
- NFPA 92A - 2000 Smoke Control Systems
- NFPA 92B - 2000 Smoke Management Systems in Malls, Atria, and Large Areas
- NFPA 101- 2000 Life Safety Code®
- UL 864 - Control Units for Fire Protective Signaling Systems.
- UL 268 - Smoke Detectors for Fire Protective Signaling Systems.
- UL 268A - Smoke Detectors for Duct Applications.
- UL 217 - Single and Multiple Station Smoke Alarms
- UL 521 - Heat Detectors for Fire Protective Signaling Systems.

- UL 228 - Door Closers-Holders, With or Without Integral Smoke Detectors.
- UL 464 - Audible Signaling Appliances.
- UL 38 - Manually Actuated Signaling Boxes for Use with Fire-Protective Signaling Systems
- UL 346 - Water flow Indicators for Fire Protective Signaling Systems.
- UL 1971 - Signaling Devices for the Hearing-Impaired.
- UL 1481 - Power Supplies for Fire Protective Signaling Systems.
- UL 1711 - Amplifiers for Fire Protective Signaling Systems.
- UL 1635 - Digital Alarm Communicator System Units
- Factory Mutual (FM) approval

Fire Alarm Panel (FACP)

General

The main FACP Central Console shall contain a microprocessor based Central Processing Unit (CPU). The CPU shall communicate with and control the following types of equipment used to make up the system: intelligent addressable smoke and thermal (heat) detectors, addressable modules, panel modules including initiating circuits, control circuits, and notification appliance circuits, local and remote operator terminals, annunciators and other system-controlled devices. The Contractor shall undertake the responsibility of the complete installation, commissioning, user trials, training and maintenance of the System as required. The Contractor shall take all responsibility for preparation and installation of System Software into the FACP. The Software shall be such so as to be easily operated by the Employer's Personnel and secured against Software errors, ability to be upgraded so as to incorporate more features at a later date.

The panel shall also have automatic dialer with speech processor for transmit fire message to select telephone numbers in case of fire.

The fire alarm control panel shall meet the modular listing requirements of Underwriters Laboratories Inc. The control panel shall be capable of expansion via Loop cards. Each Loop shall support a minimum of 160 analog addressable detectors/devices. The System shall be fail safe and adequate safe guards should be under taken that in the event of a failure of a part of the System, say a loop card or CPU, it shall not handicap the complete System. The Loop Control Module shall contain its own microprocessor and shall be capable of operating in a local/degrade mode (any addressable device input shall be capable of activating any or all addressable device outputs in that loop) in the unlikely event of a failure in the main CPU. The logic circuitry shall be based on high noise immunity solid state hardware.

All addressable units shall be connected to the FACP through the Loop Cards and shall be addressed through individual numbers. The FACP shall be able to obtain analogue value for all detectors in the circuit through a pulsed digitalized current data. The FACP shall be able to analyze all analogue inputs from all addressable units, and through its own software and ambient level screening the FACP shall be able to identify fire, possible fire or fault conditions. The unit supervision shall be dynamic and continuous.

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The FACP shall also give adequate warning signal whenever there is dust accumulation in detectors, and up to the point of its replacement it should be possible to change the level of ambient alarm calibration condition either by the use of software program operable by the Employer or by resetting the detector.

Short / Open circuit units shall also be reported at the FACP In such cases, the system through the use of fault isolators shall be able to isolate that segment between the two fault isolators. The missing detectors / Devices shall also be reported at the FACP with identification of the location.

The Contractor shall also undertake to trip the AHUs from the Fire Alarm Panel through the use of Addressable Output Modules and necessary AC / DC relays, activated by the fire signal of specified detectors and Input Modules for monitoring contacts from Fire exit doors.

The FACP shall also be able to discriminate between false alarms and fire conditions, as well as priority selection of alarm in case alarm activates in two or more remotely located units simultaneously. In such cases, the Manual Call Points shall have the highest priority.

The FACP shall have its own Battery Backup of a minimum of 8 hours in normal run and then half an hour in alarm condition. The Battery shall be of sealed lead acid re chargeable maintenance free type. Necessary battery calculations for the system shall be provided along with the bid.

It shall be able to withstand temperature variations from 0 deg centigrade to 50 deg centigrade. Further, Relative Humidity (non-condensing type) up to 95% shall not hamper its performance. The voltage rating shall be from 17V DC to 31V DC, though the voltage may be change depending upon the working voltages of a proprietary FACP.

The FACP shall also capable of repeating all the events & messages to a Passive repeater Panel.

The Fire Alarm Control Panel shall include a full featured operator interface control for the field programming and control of the fire alarm system. All programming or editing of the existing program in the system shall be achieved without special equipment and without interrupting the alarm monitoring functions of the fire alarm control panel.

Panel Controls/ Indication

Display & Indication: The backlit LCD display shall at least be of 168 characters that indicate all information associated with the fire alarm condition, including the type of alarm point and its location within the protected premises. It shall also provide Light- Emitting-Diodes (LEDs), that indicate the status of the following minimum system parameters: POWER STATUS, TEST STATUS, FIRE ALARM, FAULT, CPU FAILURE, POINTS DISABLED etc.,

Alarm Acknowledge: Activation of the control panel acknowledges function in response to new alarms and / or troubles shall silence the local panel piezo electric signal and the associated LED on the panel shall be turned ON.

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Signal Silence: Signal Silence function shall cause all programmed alarm notification appliances and relays to return to the normal condition. The selection of notification circuits and relays that are silence able by this switch shall be fully field programmable within the confines of all applicable standards.

System Reset: Depression of System Reset switch shall cause all electronically latched initiating devices to return to their normal condition. And the system reset operation starts. The associated Yellow LED shall flash during this operation to inform the user of the progress status of the reset cycle. The LED shall flash fast during the smoke detector power down sequence, then it shall flash slowly during the restart phase, and shall illuminate steadily for the restoral phase. The LED shall go out completely when the system is back to normal mode.

Evacuation/ Fire drill: Depression of the Drill switch shall activate all programmed notification appliance circuits. The drill function shall latch until the panel is silenced or reset.

Lamp Test: The Lamp Test function shall activate all local system LEDs, light each segment of the liquid crystal display to check all the components are working OK.

Panel Functions:

The FACP shall minimum perform the following functions

Supervise and monitor all intelligent addressable detectors and monitor modules connected to the system for normal, trouble and alarm conditions. System response to any alarm condition must occur within 3 seconds, regardless of the size and the complexity of the installed system.

Supervise all initiating signaling and notification circuits throughout the facility by way of connection to monitor and control modules.

Detect the activation of any initiating device and the location of the alarm condition. Operate all notification appliances and auxiliary devices as programmed. Visually and audibly annunciate any trouble, supervisory, security or alarm condition on operator's terminals, panel display, and annunciators.

Upon alarm activation of any area smoke detector, heat detector, manual pull station, sprinkler water flow, **the following functions shall automatically occur:**

The internal audible device shall sound at the FACP.

Display the alarm event on the IBMS graphical workstation.

The LCD Display shall indicate all applicable information associated with the alarm condition including: zone, device type, device location and time/date.

BIT

Any remote or local annunciators LCD/LEDs associated with the alarm zone shall be illuminated.

The following audio messages and actions shall occur simultaneously:

A pre-evacuation message shall be sounded on the entire floor with a tone preceding & succeeding the message. It is the intent of this message to advise occupants hearing this message that they are near danger and await further instructions for leaving the building via the stairs (nearest exit).

Activate visual strobes /Sounders based on programmed sequence. The visual strobe shall continue to flash or the sounders will hoot until the system has been reset.

An alert message shall be transmitted through a telephone line on a preprogrammed telephone number.

Activate automatic smoke control sequences such as AHU tripping

All automatic events programmed to the alarm point shall be executed and the associated outputs activated.

All Access Controlled doors shall unlock throughout the building.

Panel Features

The system shall be fully supervised for all fault conditions with distinctive alarm operated for fault and fire conditions. Test buttons and software features shall be provided to test the electronic circuits and detector health.

System Programming: Advanced Windows based software shall be used to configure the system during system start-up or system commissioning. Time and Date Stamps of all modifications made to the program must be included to allow full retention of all previous program version data. All System operational software is to be stored in FLASH memory. Control Panel disassembly and replacement of electronic components of any kind shall not be required in order to upgrade the operations of the installed system to conform to future application code and operating system changes. It shall have the ability to download all system applications programs and “firmware” from a computer through a single point into the FACP.
The system shall recognize specific device type ID's and associate that ID with the corresponding address of the device.

***Event Buffer*:** The panel shall maintain a history file of at least the last 1000 events, each with a time and date stamp. History events shall include all alarms, troubles, operator actions, and programming entries.

BIT

Early warning capability: To obtain early warning of incipient or potential fire conditions, the system shall support a programmable option to determine system response to real time detector sensing values above the programmed setting.

It shall be possible to set individual smoke detectors for pre-programmed pre-alarm thresholds. If the individual threshold is reached, the pre-alarm condition shall be activated and an alert displayed on the panel.

When the detector reaches a level exceeding the pre-programmed level, the control panel shall indicate an action condition. Sounder bases installed with either heat or smoke detectors shall automatically activate on action Pre-Alarm level, with general evacuation on alarm level.

Alarm verification delay: The FACP shall provide means to cause alarm signals to only sound in specific areas with a delay of the alarm after start of alarm processing. If the alarm is not acknowledged within programmed delay, all local and remote outputs shall automatically activate immediately. The control panel shall ignore the alarm verification timer if another alarm is detected during the verification period.

***Enable/ Disable points*:** The FACP shall allow the operator to restore a disabled point (device) in the system, allowing that point (device) to operate as originally intended by the application program of the system. Additionally, the system shall allow the operator to restore any group function, function, Panel, system module, “software - defined zone”, operator control, or time control function.

The FACP shall allow the operator to disable any point (device) in the system, inhibiting that point (device) from operating as originally intended by the application program of the system. Additionally, the system shall allow the operator to disable any group function, function, Panel, system module, “software - defined zone”, operator control, or time control function within the system.

***Check/Alter parameters*:** The system shall allow the operator to manually turn on any system output point, or system function. Alter Smoke Detector sensitivity, message routing within the system shall be modifiable with this simple command from the control panel.

The system shall allow the operator to restore the primary (application program defined) operation to the Smoke Detector sensitivity and the message routing functions with this simple command from the control panel.

The system shall allow the operator to manually command and control relays. Relays shall be able to be commanded to “Latch”, to energize as a “High Priority”, or as a “Low Priority”, to “Energize”, or to “De-Energize”.

AHU Shutdown The panel shall be capable of shutting down the AHUs in the event of Fire Alarm. It shall be possible to program the shut-on zone basis.
Sensitivity Adjust: The system shall provide Automatic Detector Sensitivity Adjust based on Day/Night schedules.

BIT

System Status Display

The system shall allow the operator to determine the status of individual system components, including active points, disabled points, and active points by panel.

The LCD shall show the system time, and the number of active points and disabled points in the system in this section of the LCD Display.

The LCD shall show the first active event of the highest priority. The text shall show the sequence number in which the displayed event was received, as well as its event type. It shall also display an identification message related to the displayed event.

The LCD shall show the total number of active events in the system, by event type. There shall be at least three different System Event Types that shall be displayed, “Alarm Events”, “Supervisory Events” and “Active Trouble Events”. The Main LCD shall include queues for each of the System Event Types. The Main LCD shall allow the operator to access to the System Status information contained within those queues by pressing an associated select switch. Whenever there is an unacknowledged event in any of the System Event queues, the associated Status LED shall flash. Viewing each event listed in a queue shall acknowledge all events in that queue, and shall cause the associated LED to illuminate steady.

Passwords and Users: The system shall support at least two password levels, master and user. Passwords shall be available, each of which may be assigned access to the programming change menus, the alter status menus, or both. Only the master password shall allow access to password change screens.

Report Generation capability: The system shall have the capability to connect to a printer to print at least the following

It shall give a detailed description of the status of certain system parameters for corrective action, or for preventative maintenance programs. The system shall provide these reports via the Main LCD, and shall be capable of being printed on any of the connected system printers.

The system shall provide a report that gives a sensitivity listing of all detectors that have less than 75% environmental compensation remaining.

The system shall provide a report that provides a sensitivity listing of any particular detector or all detectors

The system shall provide a listing of all of the firmware revision listings for all of the installed network components in the system.

Enclosures: The control panel shall be housed in cabinet suitable for surface or semi flush mounting. The cabinet and front shall be corrosion protected, given a rust-resistant prime coat, and manufacturer's standard finish.

BIT

The back box and door shall be constructed of steel with provisions for electrical conduit connections into the sides and top.

The door shall provide a key lock and shall include a glass or other transparent opening for viewing of all indicators. For convenience, the door may be site configured for either right- or left-hand hinging.

Power Supply: The Addressable Main / auxiliary Power Supply shall operate on 120/240 VAC, 50/60 Hz, and shall provide all necessary power for the FACP and the notification appliances.

The Addressable Main Power Supply shall also incorporate a battery charger for 8 hours of standby power for normal working & another ½ hour in alarm condition using dual-rate charging techniques for fast battery recharge The Addressable Main Power Supply shall provide a very low frequency sweep earth detect circuit, capable of detecting earth faults.

The Addressable Main Power Supply shall be power-limited per 1995 UL864 requirements.

The FACP shall have UL/ FM / ULC approval.

Detectors

The Detector shall be analogue addressable type. The chamber should be easily removable for the purpose of easy maintenance. The address programming shall be done at site only. The detectors shall have a common base to allow easy interchange of various types of detectors.

Addressable Smoke cum Heat Detector

All Smoke cum Heat detectors shall be fitted with plug-in system type connections, from the maintenance and compatibility point of views. An alarm release will not affect a detector's good functioning. After resetting the alarm, the detector will resume operations without readjustment of any kind. The smoke cum heat detector shall have a linear response over all types of fire. It shall be possible to use only a single detector type/model for both above and below false ceiling applications. The detector shall be capable of detecting fast flaming fires and slow smoldering fires equally well.

The smoke cum heat detector shall be able to sense incipient fire by detecting the presence of visible and invisible products of combustion. The detector shall be suitable for low voltage (17 to 31V DC) two wire supply. The detector shall be provided with Twin LED indication and the sensitivity of the detector shall not vary with change in ambient temperature, humidity, and pressure or voltage variation.

Neither its performance shall be affected by air current up to 1.52mtr per second. The detector shall be suitably protected against dust accumulation/ ingress and it shall be free from maintenance and functionally tested at intervals. All detectors shall be identical in construction design and characteristic to facilitate easy replacement.

BIT

The Smoke cum heat detector shall be Analogue Addressable type and be able to send analogue output to the FACP regarding its condition. It shall be able to communicate with the FACP by the pulses emitted from the FACP. It shall have in-built locking mechanism to check the removal and pilferage of the detector. The quiescent current flow must not exceed 400 microamps and alarm condition current shall be maximum 40 milli amps. The base of the Detector shall be electronics free and interchangeable with other smoke or heat detectors. The enclosure shall meet IP 42 protection grade.

It shall be able to withstand temperature variations from - 10 degree centigrade to 50 degrees centigrade. Further, Relative Humidity (non-condensing type) up to 80% shall not hamper its performance. The voltage rating shall be from 17V -31V DC though the voltage may be changed depending upon the working voltages of a proprietary FACP. The smoke Detector shall have UL /FM/ approval.

The detector shall have twin LEDs for 360 degree viewing angle. LED on the detector shall blink each time the sensor is scanned by the FACP. If the FACP determines that the sensor is in alarm, the FACP will command the sensor LED to remain on to indicate the same. Each sensor will be capable of being tested for alarm via command from the FACP. Each sensor shall respond to FACP scan with the information about its type for identification. The detector shall be programmed using a hand-held programmer and address stored in a non-volatile memory within the sensor or by a decade /Rotary switch.

Addressable Heat Detector

Heat detector shall provide temperature measurement when it reaches pre-alarm in normal course. However, the operator shall have the option of calling up the temperature measured by the specific detector as and when required.

It shall have in-built locking mechanism to check the removal and pilferage of the detector. The quiescent current flow must not exceed 400 micro amps and alarm condition current shall be maximum 40 milli amps.

The heat detector shall be Analogue Addressable type and be able to send analogue output to the FACP regarding its condition. It shall be able to communicate with the FACP by the pulses emitted from the FACP. The detector shall be programmed using a hand-held programmer and address stored in a non-volatile memory within the sensor or by a decade /Rotary switch or shall be through an electronic addressing.

The base of the Detector shall be electronics free and interchangeable with other smoke or heat detectors. The enclosure shall meet IP 42 protection grade.

It shall be able to withstand temperature variations from - 10 degree centigrade to 50 degrees centigrade. Further, Relative Humidity (non-condensing type) up to 80% shall not hamper its

performance. The voltage rating shall be from 17V -31V DC though the voltage may be changed depending upon the working voltages of a proprietary FACP

The Detector shall have UL/FM/ approval. It shall be possible to test the Detectors working from the FACP.

The detector shall have twin LEDs and shall have 360 degree viewing angle. LED on the detector shall blink each time the sensor is scanned by the IFAS. If the FACP determines that the sensor is in alarm, the FACP will command the sensor LED to remain on to indicate the same. Each sensor will be capable of being tested for alarm via command from the FACP. Each sensor shall respond to FACP scan with the information about its type for identification.

Double Action Manual Pull Station

The Double Action Manual Pull Station shall be addressable type with built in input modules to define the location. It shall come with a key operated reset lock for testing.

The device shall be of durable extruded aluminum or moulded poly carbonate LEXAN housing construction, red in colour and suitable for surface or flush mounting. The word FIRE shall appear in front of the Station in white colour. A clearly visible Single/Multi Colour LED shall be provided which shall flash while polling & shall be permanently illuminated during alarm until reset.

Activation of Manual Pull Station shall initiate operation of the alarm detection circuit. The manual station shall have normally open fire alarm and annunciators contacts and these contacts shall close on activation. Contacts shall remain closed until station is manually reset. Resetting shall be accomplished by re positioning the handle / pull station door and relocking the key lock.

The address of the Pull station shall be done through the built in DIP, Decade, Rotary switch or through electronic addressing.

The Manual Call Station shall be fully addressable with its own addressable module and operated by digitized signals from the FACP. The voltage range shall be from 17V to 31V. The operating temperature range shall be minimum from 0 degree C to 48 degree C. Relative Humidity (non condensing) range of performance parameters shall be between 0 to 95%.

The Manual call point shall have UL/FM/ approval

Short Circuit Isolator (Fault isolation module)

This unit shall be placed on the loop preferably after every 20 devices and shall be able to isolate electrical short circuit in the wiring. All the other detectors shall remain functional because of the Class A wiring of the loop.

Isolator modules/Base shall be provided to automatically isolate wire-to-wire short circuits on an SLC Class A or Class B branch. The isolator module shall limit the number of modules or

detectors that may be rendered inoperative by a short circuit fault on the SLC loop segment or branch. At least one isolator module shall be provided for each floor or protected zone of the building.

If a wire-to-wire short occurs, the isolator module / Base shall automatically open-circuit (disconnect) the SLC. When the short circuit condition is corrected, the isolator module shall automatically reconnect the isolated section.

The isolator module / Base shall not require any address-setting, and its operations shall be totally automatic. It shall not be necessary to replace or reset an isolator module after its normal operation.

It shall provide a single LED that shall flash to indicate that the isolator is operational and shall illuminate steadily to indicate that a short circuit condition has been detected and isolated. The Isolator shall have UL/FM/ approval.

Sounder cum Strobe

The sounder cum strobe shall be electronic type and shall give discontinuous/ intermittent audible alarm from a command from the Addressable Bell relay modules whenever any detector or call box operates.

The sound output from the sounder should not be less than 100 decibels at the source point. It shall be capable of being directly mounted on the wall/ceiling. The sounder cum strobe shall be programmed to get activated in event of an alarm from a single detector/device or a group of detectors/ devices.

The strobes shall be an electronic visible warning signal device that flashes at least once every 1.5 Secs in an event of an alarm. The strobe light shall use Xenon flash tube with low current requirements. The outer cover of the Strobe shall have a printed fire signal warning. The electronic circuits inside the strobes shall be compatible with DC alarm supervision & meet the required safety standards. The strobes shall be mounted on the sounder or on the wall/ceiling and shall be UL Listed.

It shall be capable of being directly mounted on the wall/ceiling. The sounder relay module shall be programmed to activate the sounders in a wing in event of an alarm from a single detector/device or a group of detectors/ devices.

The Sounder & Strobe shall have UL/FM/ approval.

Addressable Control Relay Module

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Output module shall mean addressable points from the FACP with potential free contacts for tripping of AHUs, Operating Strobe lights, tripping power supply etc. as required. The system shall also be able to handle separate modules to interface the speakers of the Public Address System. The Module shall have shall have UL/FM/ approval.

Addressable Input Module (Monitor module)

The input modules shall be used for interfacing Fire status of Gas release panel, Fire, Fault status of VESDA, Fire Door status monitoring, Sprinkler flow status etc., with the proposed fire alarm system.

The Module shall have shall have UL/FM/ approval

Duct Housing Addressable Smoke Cum Heat Detector

The Duct Housing shall be placed in each return air duct to Sense Smoke in the return air. The Duct Housing shall accommodate the addressable Smoke cum heat detector as specified above. The Housing shall be capable of withstanding air velocities from 500 to 4000 FPM. It shall have the facility to connect a remote LED. It shall be capable of mounting easily into rectangular or circular ducts. It shall have an integral filter system to reduce dust. Sampling tube shall be easily installed after the housing mounted to the duct.

The duct detector housing shall incorporate an airtight smoke chamber for mounting the detector. The housing shall be capable of mounting either in rectangular or circular ducts. The sampling tube both for inlet & outlet shall be easily installed after housing is mounted to the duct by passing through the duct housing. The sampling tube shall be supplied to cover the entire duct width. The sampling tube should be from the duct housing manufacturer only.

It shall be capable of Local Testing using a test Magnetic switch. The unit shall be reset using a local reset button. **The Duct housing shall have UL approval.**

Integration with Access Control System

In an event of a Fire Alarm the fire alarm panel from its in built programmable relays shall send a signal through a potential free contact to the nearest access door controller and in turn the Controller will transmit the door open command to all the doors for automatic opening of all doors.

Integration PA system with the Fire Control Panel.

Necessary Interface unit/ modules shall be provided for integrating the PA system. In an event of fire, the fire alarm system shall trigger the P.A to generate a tone, make a preprogrammed announcement & end with a tone.

Power Supply Unit

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The 1/ 5 Amp power supply unit shall be with 24 Volts, 7Ah sealed maintenance free lead acid battery. It shall have an inbuilt trickle and boost charger. An indication shall be provided to indicate the availability of AC power source. An inbuilt buzzer shall be provided which shall indicate that the battery is in deep discharge condition. This power supply unit status shall be monitored by the FACP. Necessary addressable modules shall be considered for the same while quoting for power supply unit

Active Repeater Panel

The Repeater panel shall be connected to the FACP through a RS485 communication. It shall be powered from the Main FACP & shall be supplied with necessary interface cards for connecting to FACP. It shall be possible to reset the system, acknowledge event & mute sounders of all panels connected to it.

The Panel shall have minimum 2 x 40 characters back lit LCD display which will repeat all the events, alarms, messages displayed by the FACP.

The Repeater Panel shall have the following LEDs for displaying the following events

- FACP System Status
- FACP on DC Power
- FACP in under Fault
- FACP is displaying Fire
- An event is acknowledged at FACP
- Sounders silenced at FACP
- Input/ Output disabled in FACP

Fire Alarm System Testing

The correctness of cabling with continuity as per the approved shop drawings. System design & configuration check, Access Control System integration test.

FACP

The FACP shall be checked for basic tests such as visually checking input voltage and amperage. All the loops one by one shall be de wired to check for fault signal indication in the FACP. The Power Source shall be cut off and checked for stand by Supply from the Batteries. After six hours the FACP Source shall be switched on to check for auto switch over to the Mains mode. The operation LCD/LEDs in the FACP facia is tested. Walk Test of Detectors/ Devices to be checked from the FACP.

TECHNICAL SPECIFICATION FOR ASPIRATING SMOKE DETECTION SYSTEM

SCOPE OF WORK

This specification covers the requirements of supply of materials, installation, testing and commissioning of Aspirating Smoke Detection System. The system shall include all equipment's, appliances and labour necessary to install the system, complete with highly

sensitive LASER-based Single Channel Smoke Detectors with aspirators connected to network of sampling pipes **which can cover 3 voids of area approx. 35 Sq mars.**

CODES AND STANDARDS

The entire installation shall be installed to comply one or more of the following codes and standards:

NFPA Standards, US & British Standards, BS 5839 part: 1

DESIGN REQUIREMENTS

The System shall consist of a highly sensitive LASER-based smoke detector, aspirator, and filter. It shall indicate the smoke detected in each zone. It shall also be possible to set the smoke threshold level in each channel independently either through a hand-held programmer or through the graphics software**.**

It shall have a display featuring LEDs and Reset/Isolate button. The system shall be configured by a programmer that is either integral to the system, portable or PC based.

The system shall allow programming of:

- Multiple Smoke Threshold Alarm Levels.
- Time Delays.
- Faults include airflow, detector, power, filter block and network as well as an indication of the urgency of the fault.
- Configurable relay outputs for remote indication of alarm and fault Conditions. It shall consist of an air sampling pipe network to transport air to the detection system, supported by calculations from a computer-based design modeling tool.

Optional equipment may include intelligent remote displays and/or a high-level interface with the building fire alarm system, or a dedicated System Management graphics package.

PERFORMANCE REQUIREMENTS

- You should provide very early smoke detection and provide multiple output levels corresponding to Alert, Action, Fire 1 & 2. These levels shall be programmable and shall be able to set sensitivities ranging from 0.005 – 20% obscuration / meter.
- Shall report any fault on the unit by using configurable fault output relays or via the graphics Software.
- Shall monitor for filter contamination.
- Shall incorporate a flow sensor in each pipe and provide staged airflow faults.

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MATERIALS AND EQUIPMENTS

Both Light Scattering and Particle Counting shall be utilized in the device as follows:

The Laser detection Chamber shall be of the mass Light Scattering type and capable of detecting a wide range of smoke particle types of varying size. A particle counting method shall be employed for the purposes of preventing large particles from affecting the true smoke reading.

Monitoring contamination of the filter (dust & dirt etc.) to notify automatically when maintenance is required. The Laser Detection Chamber shall incorporate a separate secondary clean air feed from the filter; providing clean air barriers across critical detector optics to eliminate internal detector contamination.

The detector shall not use adaptive algorithms to adjust the sensitivity from the set during commissioning. A learning tool shall be provided to ensure the best selection of appropriate alarm thresholds during the commissioning process.

DETECTOR ASSEMBLY

The Detector, Filter, Aspirator and Relay Outputs shall be housed in a mounting box and shall be arranged in such a way that air is drawn continuously from the fire risk area by the Aspirator and a sample passed through the Dual Stage Filter and then to the detector.

The detection unit shall include scanning valve mechanism to identify which sampling pipe is carrying smoke. And it shall be LASER-based and shall have an obscuration sensitivity range of 0.005 – 20% orbs/m.

The valve mechanism shall be integrated in to the detector. It shall sample each pipe individually upon detection of smoke. The detector shall also identify the level of smoke in each pipe and indicate in which pipe the alarm is detected. The system shall utilize the principle of sampling all the sectors simultaneously.

The detector shall have three/four independent field programmable smoke alarm thresholds across its sensitivity range with adjustable time delays for each threshold between 0 - 60 seconds.

The Detector shall also incorporate facilities to transmit the following faults.

a) Detector, b) Airflow, c) Filter, d) System, e) Zone, f) Network, g) Power
h) Urgent and Minor faults. Minor faults shall be considered as servicing or maintenance signals. Urgent fault shall indicate that the unit may not be able to detect.

The detector shall have single / multiple pipe inlets which must contain a flow sensor. Both Minor and Urgent flow faults shall be reported.

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The filter must be a two-stage disposable filter cartridge. The first stage shall be capable of filtering particles in excess of 20 microns from the air sample. The second stage shall be ultra-fine, removing more than 99% of contaminant particles of 0.3 microns or larger, to provide a clean air barrier around the detector's optics to prevent contamination and increase service life.

The aspirator shall be a purpose-designed rotary vane air pump. It shall be capable of allowing/ supporting for a single pipe run / multiple sampling pipes runs with a transport time of less than 90 seconds.

The Assembly must contain relays for fire alarm and fault conditions. The relays shall be software programmable (latching or non-latching). The relays must be rated at 2 A at 30V DC. Remote relays shall be offered as an option and either configured to replicate those on the detector or programmed differently.

The Assembly shall have built-in event and smoke logging. It shall store smoke levels, alarm conditions, operator actions and faults. The date and time of each event shall be recorded. Each detector (Zone) shall be capable of storing up to 12000 /18,000 events.

SAMPLING PIPE

The PVC sampling pipe shall be smooth bore with an internal diameter between 15-25 mm. Normally, pipe with an outside diameter of 25mm and internal diameter of 21mm should be used. The PVC pipe material should be suitable for the environment in which it is installed, or should be the material as required by the specifying body.

All joints in the sampling pipe must be air tight except at entry to the detector. The PVC pipe shall be identified as Aspirating Smoke Detector Pipe along its entire length at regular intervals not exceeding the manufacturer's recommendation or that of local codes and standards.

All PVC pipes should be supported at not less than 1.0 m centers, or that of the local codes or standards. The far end of each trunk or branch pipe shall be fitted an end cap and drilled with a hole appropriately sized to achieve the performance as specified and as calculated by the system design. Each zone shall cater to minimum 40 mtrs of piping. Kitchen are use 25dia GI conduit .

The sampling pipes shall be mounted using full threaded rods, with necessary hooks for fixing them on the metal truss. No modification, welding, making holes allowed in the truss. The fixing accessories shall be chosen accordingly.

SAMPLING HOLES

Sampling Holes of 2 – 6 mm, or otherwise appropriately sized holes, shall not be separated by more than the maximum distance allowable for conventional detectors as specified in the local codes & standards. Intervals may vary according to calculations.

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Each sampling point shall be identified in accordance with Codes or Standards.

Consideration shall be given to the manufacturer's recommendations and standards in relation to the number of Sampling Points and the distance of the Sampling Points from the ceiling and roof structure and forced ventilation systems. The sampling points at the false ceiling level shall be provided with VESDA make Tees, capillary tubes & nozzles.

INSTALLATION

The Contractor shall install the system in accordance with the manufacturer's recommendation.

Where false ceilings are available, the sampling pipe shall be installed above the ceiling, and Capillary Sampling Points shall be installed on the ceiling and connected by means of a capillary tube.

The minimum internal diameter of the Capillary tube shall be 5mm, the maximum length of the capillary tube shall be 2m unless the manufacturer in consultation with the engineer have specified otherwise.

The Capillary tube shall terminate at a ceiling Sampling Point specifically approved by the Employer. The performance characteristics of the sampling points shall be taken into account during the system design.

Air sampling piping network shall be laid as per the approved pipe layout. Pipe work calculations shall be submitted with the proposed pipe layout design for approval.

TESTING

The testing procedure for checking the installation, quality and performance of the system shall be submitted by the Contractor and the same shall be approved by the consultant / client.

FUNCTIONAL TEST.

Introduce Smoke into the Detector Assembly to provide a basic functional test.

Introduce smoke to the least favorable Sampling Point in each Sampling Pipe. Transport time is not to exceed 90 Secs.

AUTOMATIC INTEGRATED VOICE EVACUATION SYSTEM.

This shall comprise of a fully monitored automatic voice evacuation system designed and installed as per specification. The system shall have FM approval and the components shall be UL listed.

GENERAL

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The main objective of the P.A. System shall be used to convey clear and audible instructions to all the people on all floors / buildings in case of occurrence of fire / other emergency to reach a place of safety in the open, outside the buildings. The sound output should not be so loud that people nearest to the speakers feel uncomfortable, nor so weak that people away cannot discern what is being broadcast. This is achieved by working the system at 60 to 75% power output and distributing speakers uniformly all over floor area.

APPLICABLE CODES AND STANDARDS.

The following codes and standards shall be used as minimum requirements for the Public address system. All NFPA standards shall be as amended by the National Fire Protection Association, most current revision(s).

- NFPA 72 2002 - National Fire Alarm Code.
- NFPA 90A - Installation of Air Conditioning and Ventilating Systems (Duct Smoke Detector Requirements).
- NFPA 101 - Life Safety Code.
- NFPA 70 - National Electric Code.
- NFPA 318 – Standard for Protection of Clean rooms.
- UL - Underwriters Laboratory.
- Local codes as applicable

SYSTEM DESCRIPTION

The Public Address system shall be a proprietary system as defined in NFPA 72, 2002.

The Control equipment shall be microprocessor system dedicated to the building fire alarm and audible evacuation system. Applications, Project Team may select from other locally available vendors as approved by the client. The system shall be a distributed, peer-to-peer network, fully field programmable, and Owner programmable. The system shall be installed in the pattern of zones, for which necessary modules shall be considered in the quoted prices. Each zone shall consist not more than speakers as indicated in drawing of 6 watts capacity.

The Control panel shall be fully integrated type with multi channel digitized voice channels, auxiliary audio source integration provision, programmable zone selector switches with LCD screen and shall be seamlessly integrated with the FACP. The system shall be located in the command center console. All Fire fighters telephone activation shall be monitored, supervised and displayed at the command center console.

Provide electrically supervised system, with supervised speaker zones indicating circuits. Occurrence of single ground or open condition in the system or signaling circuit places circuit in TROUBLE mode. Component or power supply failure places system in TROUBLE mode.

The audible evacuation portion of the fire alarm system shall be an overhead distribution system. System performance priorities as follows:

- Audible clarity.

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- 15 db minimum above area ambient noise level.
- 120 db maximum sound pressure level.

For voice evacuation, the system shall accept input signals from a microphone and recorded messages and shall accept input alarm signals and evacuation information from the fire alarm control equipment.

The evacuation system shall provide building and/or zone coverage as mentioned above. Control shall be such that an individual building or floor can be evacuated, or any combination of buildings from one to all buildings may be selected for evacuation by the command center. Each building shall have a standalone audio control panel capable of voice and tone evacuation for that building. Also note that system shall able to generate the pre- alarms (recorded messages as per clients) initially then the evacuation alarms shall through.

The Amplification shall be rack mounted distributed type with 12 hrs internal power Backup in normal condition and 1 hr in fully activated alarm condition. Provision should be there for Power brownout audible alarm, tolerance to faulty power condition. Amplifiers should be isolated from field PA zone wiring and no direct AC power termination on amplifiers is permissible. Vendor shall consider suitable type & size rack for mounting the Amplifiers, microphones etc.

The tack back system speakers with talk push button should be located near all stair case entry along with MCP and hooter. A separate microprocessor based public address system consol of required zone with goose neck – microphone and amplifier shall be used for fire emergency stair case. The same system should be located near security desk area.

FIELD QUALITY CONTROL

Public Address shall be tested in accordance with an equipment verification test and a final acceptance test created and provided by the system vendor. Where a system vendor is not used, the above responsibility shall fall to the Contractor scope.

LIQUID LEAK DETECTION SYSTEM

SCOPE

Work Included Liquid leak detection system in server Room. The system shall include control panels, wiring, detectors, accessories and other miscellaneous items like monitor / control modules as required for a complete functioning system.

Water leak detection system shall be designed and installed inside the server room to detect water leaks, if any. System shall be distributed type with digital type sensing cable, connectors and modules etc.

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SYSTEM DESCRIPTION

The completed liquid leak detection system shall operate in a local automatic fashion. The system shall provide alarm and supervisory relay closure information to the life safety system. The system shall, at a minimum, also have the ability to transmit information to IBMS for remote monitoring via serial interface or current loop. The system should have the capability of transmitting system data over TCP/IP(LAN/WAN) to a remote Graphics Map locator application on a PC.

The system shall be capable of reporting multiple leaks from a single sensing zone. The system shall also have multi-zone sensing capability. The alarms shall report to the control panel and shall indicate approximate location of leak along the cable length.

Sensing shall be accomplished by detector cable lengths installed within annular space of, containment trenches, or designated floor areas.

Zoned sensing shall be done by zone branches reporting the alarms to the control panel indicating the zone number(s) at the occurrence of a leak.

Sensor cable shall be chemically resistant, and suitable for water per detection requirements.

The system shall be composed of: sensing cable(s), jumper cable(s), leader cable(s), and alarm/locator panels. Alarm/locator panel shall have output relays for alarm and supervisory signals to the life safety system. The panel shall be configured to monitor for power loss or other internal failure.

A continuity relay shall be provided within the alarm/locator panel. An RS-485 port that transmits alarm data may also be used, but not instead of output relays described above.

The system shall include wiring, conduit, pull boxes, hand holes, terminal cabinets, outlet and mounting boxes, control equipment, detectors, and all other accessories and miscellaneous items required for a complete, operational system**.**

REGULATORY REQUIREMENTS

A. System: UL and FM listed.
B. Conform to applicable local codes.
C. Suitable to monitor in FA

FIELD QUALITY CONTROL

A. The system shall be installed, tested, and adjusted under the supervision of a manufacture's certified technician.

B. A field walk shall be conducted with the client / consultant prior to system acceptance and for cable installation and demolition to identify items that may need to be addressed.

7.5

ELECTRICAL WORKS-
TECHNICAL SPECIFICATION

BIT

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1 LOW TENSION CABLES: -

1.1 TYPE:

Low voltage cables shall be Aluminum/ Copper conductor, PVC insulated. XLPE/PVC sheathed and steel wire armoured or steel tape armoured construction. The conductors of cable from 16sqmm size shall be stranded. Sector shaped stranded conductors shall be used for cables of 50sqmm size and above. The cable shall conform to IS: 1554 part - I in all respects.

The XLPE cables shall be ST HR inner sheathed ST2 - FR outer sheathed as per IS - 7098 (Part-1) wire stripped.

1.2 RATING:

The cable shall be rated for a voltage of 1100 volts.

1.3 GENERAL REQUIREMENTS.

The minimum size of cable for power loads shall be 4sqmm aluminum or 2.5 sqmm copper cable.

Considering harmonic current only 4 core cables up to and including size 25sqmm shall be used for lighting loads and UPS etc.,

The cable of size up to & including 6 sqmm should be of copper conductor PVC insulated armoured or unarmored cables for lighting and raw power application.

The cables of sizes including 10sqmm and above should be of aluminum conductor XLPE insulated armoured cables for lighting and raw power application.

The cables used for UPS application should be of copper conductor PVC / XLPE insulated armoured or unarmoured cables.

The cables shall be supported at a regular interval of 450mm from end termination.

The cable glands at both end of armoured cable shall be earthed.

1.4 CORE IDENTIFICATION:

Cores shall be provided with the following colour scheme of PVC insulation.

1 Core : Red/Black/Yellow/Blue.

2 Core : Red and Black

3 Core : Red, Yellow and Blue

3 .5 / 4 Core : Red, Yellow, Blue & Black.

1.4 CABLES AND OTHER ITEMS:

i) Specifications for XLPE Cables : IS 7098 (1988- Part – I)

ii) Specification for PVC insulated (Heavy duty) electric cables for voltage up to 1100 Volts. : IS 1554 (1964 - Part - I)

iii) Specifications for PVC insulated cables for voltage up to 1100V with aluminium conductors. : IS 694 (1988 - Part - II)

iv) Glossary of terms for electrical cables and conductors. : IS 1885 (1971)

v) Code of practice for safety of buildings (General) Electrical installation. : IS 1646 - 1961

1.5 Storing:

All the cables shall be supplied in drums. On receipt of cables at site, the cables shall be inspected and stored in drums with flanges of the cable drum in vertical position.

1.6 LAYING

All cables which are used for indoor application shall be of armoured or unarmoured type and for outdoor application should be armoured cables only. Cables shall be laid as per the specifications given below:

i) CABLES BURIED UNDER GROUND.

The cable laid in outdoor application should be buried directly under ground. The depth of cable buried under ground shall not be less than 750mm from final ground level. Wherever the cable shall be buried under ground the earth excavation shall be cut square and with uniform depth.

After cable is laid and straightened, it shall be covered with a layer of sand cushioning, over this a course of tiles or burnt shall be provided on all three sides for cable protection or half round hume pipe shall be provided. Once the

cables are laid and proper testing like continuity and insulation resistance are done then excavated earth shall be filled back and consolidated.

Warning taper of 200mm wide & 100micron thick to be places just above the sand cushion below the filled soil.

The minimum cable bending radius shall not less than 12 times the diameter of cable cross section.

Approved cable markers made of cast iron indicating voltage, no cables and the direction of run shall be installed at regular inter

ii) CABLE IN INDOOR TRENCHES

Cables shall be laid in indoor trenches wherever specified. Suitable galvanized angle iron brackets, clamps, hoods and saddles shall be used for securing the cable in position.

Indoor cable trench sizes should be as indicated in GFC drawings and approved by EIC/ Architects.

After installing the panels above cable trenches, the extra gap shall be covered with 10mm thick MS plate and painted with a coat of red oxide to avoid corrosion.

1.7 Cable on Trays / racks:

Cables shall be laid on cable trays/racks wherever specified. The cables laid shall be securely fixed to the Cable trays by means of lockable nylon ties. After laying the cables the cable shall be securely fixed by using Cable Tie/ Cable binding Strip. The cost of the nylon ties and the overlapping GI strip shall be included in to the laying cost of the cable as no separate payment will be made for the overlapping strip and nylon ties.

1.8 ALUMINIUM CABLE TERMINATION METHODS

A) GENERAL REQUIREMENTS

The general requirements for terminations of Aluminium cables shall be:

a) To remove oxide from the conductor and prevent the oxide re-forming.

b) To prevent corrosion resulting from contact between dissimilar metals.

c) To retain contact pressure under cyclic loading conditions.

For all Aluminium cables, the oxide shall be removed by thoroughly wire-brushing the bare end of the cable. After brushing, a liberal coating of approved oxide-inhibiting, moisture-excluding thermally stable grease shall be applied, and the cable shall be wire-brushed again through the grease. Cable strands shall not be separated before brushing.

Bare Aluminium lugs, ferrules and other connectors, unless factory-tinned or factory pre-filled with inhibiting grease, shall be wire-brushed and contact grease coated in the same way as cables.

Before making any joints or terminations in Aluminium cables, the Contractor shall submit the proposed method to the Client/ Consultants for approval. Notice shall be given before making any joints or terminations, to enable the Client/ Consultants to witness the work.

B) **ACCEPTABLE JOINT/ TERMINATION METHODS**

Aluminium to Aluminium connections shall be made by one of the following methods:

- Aluminium crimp lugs or tinned copper lugs.
- Fusion welding with Aluminium lugs.

Tinned copper lugs shall be terminated using the compression method. For compression connections on stranded cables, a hexagonal die shall be used. On solid conductor cables, indent type dies shall be used, with at least two indentations per cable connection. Lugs shall be selected to suit the size and shape of the conductor. Compression dies shall be selected to suit the particular lug or ferrule. Aluminium crimp lugs shall be filled with oxide inhibiting contact grease.

Joints by the fusion welding method shall be made by jointers experienced in this method. Particular care shall be taken to protect the cable insulation from heat by fixing substantial heat sinks to the cable near the joint. After completion of the weld the joint shall be wire brushed and all sharp projections filed smooth.

Aluminium to copper connections shall be made by one of the following methods:

- Bi-metal connectors, or
- Tinned copper lugs or
- Electro-tinned cast Aluminium lugs.

Bi-metal connections shall consist of lugs or pin type connectors having a cast copper palm or pin, friction-welded to an Aluminium barrel section which is subsequently factory filled with oxide-inhibiting grease. The Aluminium cable shall be inserted in the barrel section and fixed using the compression method as detailed above. The copper pin or palm section shall be fixed to copper or brass connectors or bus-bars in the conventional manner.

Tinned copper lugs shall be terminated using the compression method.

Where electro-tinned Aluminium lugs are used, they shall be fixed to the cable using the compression method. The palm of the lug shall be bolted to the copper bus-bar or terminal using a bolt and nut, with one large diameter flat washer and two "Belleville" spring cup washers.

All nuts shall be adequately torque tightened to manufacturer's recommended levels. Identification tags for feeder designation shall be by using cable tags tied to either end of each cable.

All cable glands & cable armour shall be earthed properly with earthing clamps & braided copper wires.

All cable glands shall be of double compression type for higher size,single compression for low size cables & lugs shall be Aluminium for Aluminium cables & copper for copper cables.

1.9 ROAD CROSSINGS

All pipelines laid up to 1Mt below roads (FGL) or shall be taken through suitable underground trenches/ Hume pipe of suitable sizes. The size of trenches shall be as per the drawings

8. 2 HIGH TENSION CABLES

2.1 Scope :

The section covers the storing, laying, fixing, jointing/termination, testing and commissioning of high voltage XLPE insulated armoured sheathed aluminium conductor cables laid in built up trenches, directly buried underground, on cable trays, clamped directly to wall or structures etc., as called for in the drawing. The contractor shall provide all materials, labour, equipment, scaffolding etc., as required for the completion of HV cables, as called for.

a. 2.2 Standards Applicable

The following standards and rules shall be applicable:

IS 1255:83 Code of practice for installation and maintenance of power Cables up to and including 11kV rating (Amendment I)

IS 7098: 85 Cross linked polyethylene insulated PVC (Part2) sheathed cables.

IS 8130: 84 Conductors for insulated electric cables and flexible cords.

IS 5831: 84 PVC insulation and sheath of electric cables (Amendment I)

The recommendations of the cable manufacturer with regard to jointing and sealing shall be strictly followed. Installation of cables shall be done by an approved, qualified and experienced person in this trade.

2.3 Material:

- The HT cables shall be of 11000volts grade, aluminum conductor, conductor screened, CROSS LINKED POLYETHYLENE insulated, insulation screened, steel tape armoured and PVC sheathed over all conforming to IS 7098 and suitable for unearthed system laid underground or in trenches as specified in bill of materials and approved drawings.

- The conductor shall be made of Electrical purity Aluminum wires and stranded together and compacted. The cable shall be of 3 Core type.

- The insulation shall be of high-quality cross-linked polyethylene applied by extrusion process. Both conductor and the insulator are provided with shielding made of Semi Conducting compound.

- Armoring is applied over inner sheath and shall be of flat steel strips. The outer sheath shall be of heat resisting tropodure (PVC) compound. This shall be of black colour.

- The cable shall be manufactured using the dry curing and cooling process.

- The design shall allow the operation of the cable at a maximum continuous conductor temperature of not less than 90 degrees centigrade under normal conditions and short time temperature up to 250 degree centigrade during faults.

- The design and construction of the cable shall permit a minimum bending radius of 15 times the diameter or lower as per manufacture’s recommendations.

- The cable shall be supplied on non-returnable drums with both ends properly sealed to prevent entry of water.

- The In order to avoid straight through joints, single length shall be supplied as far as possible. The details of which will conveyed at the time of order

2.4 Inspection:

All cables shall be inspected upon receipt at site and checked for any damage during transit.

2.5 Joints in Cables:

The contractor shall take care to see that all the cables received at site are apportioned to various locations in such a manner as to ensure maximum utilization and avoidance of jointing cable. This apportioning shall be got approved by the Owner/Consultant before the cables are cut to lengths. Where joints are unavoidable, the location of such joints shall be got approved by the Owner/Consultant.

2.6 Jointing Boxes for Cables:

Cable joint boxes shall be of appropriate size, suitable for Aluminium conductor XLPE insulated cables of 11000 volts ratings, as required, and shall be of CCI make or approved equal.

All cable joints shall be of heat shrinkable / push on type with all cable jointing accessories ensuring electrical continuity and mechanical strength and the filling in of compound, jointing etc shall be done in accordance with manufacturer's instructions, good practice in trade and in an approved manner. All straight T-joints shall be done in epoxy mould boxes with TROPOLIN/M-SEAL epoxy resin or approved equal. All jointing accessories shall also be manufactured by Indian Cable Corporation/CCI or approved equal. All terminal ends of conductors shall be heavily soldered up to atleast 50 mm lengths.

All cables shall be jointed colour to colour and tested for continuity and insulation resistance before jointing commences. The seals of cables must not be removed until preparations for jointing are completed. Joints shall be finished on the same day as commenced and sufficient protection for the weather shall be arranged. Joints shall be made by means of suitable solder for conductors, the conductors being firmly butted into the connections or thimbles or ferrules and the whole soldered with proper solder and soldering flux or resin. The conductors shall be efficiently insulated with high voltage insulating tape as required and use of spreaders of approved size and pattern.

The joints shall be completely filled with epoxy compound being topped as necessary to ensure that the box is properly filled.

2.7 Epoxy compound shall be filled as follows:

Equal quantities of resin and hardener shall be mixed thoroughly by hand until the mixture is free from white patches and has uniform colour. No water, oil or any other liquid shall be added to the mixture to make it soft as is will affect the properties of the compound. The mixture shall be used within 30-40 minutes of mixing. The on which epoxy compound is to be used, shall be free from dust, rust, oil, grease and shall be dry. The joint neither disturbed nor moved till the epoxy compound is completely hardened. A smooth surface can be made by rubbing damp cloth smoothly on the compound before it sets. The joints shall be painted after they have completely hardened.

Alternatively, ready mix of epoxy cable jointing compounds may also be used. In all cases manufacturers' recommendations shall be strictly adhered to.

2.8 Cable Terminations:

Cable termination shall be done in terminal cable box using cable glands and the cables ends sealed with sealing compound. The cable boxes of transformers shall be filled with bituminous compound manufactured by CCI or approved equal.

2.9 Bonding of Cables:

Where a cable enters any piece of apparatus, it shall be connected to the casing by means of an approved type of armoured clamp and gland. The clamps must grip the armouring firmly to the gland or casing, so that in the event of compound movement no undue stress is passed into the cable conductors.

2.10 Laying of Cables:

HV cables shall be laid either buried directly underground in RCC Hume pipe or in Masonry/Concrete trenches. The cable buried underground shall be at minimum depth of 1Mtr. from the ground level. Sand cushion of not less than 80mm shall be provided both above and below the cable with a protective concrete slab / tiles / bricks on the top of the sand layer as per detailed drawings and BOQ. The cable trench shall be back filled and compacted.

2.11 Protection of Cables:

The cable shall be protected by placing precast reinforced 50mm thick (1:2:4) concrete slabs 200mm wide / bricks / half hume pipe tiles on the top layer of sand for the length of the cable. Where more than one cable is running in the same trench, the concrete blocks / bricks / tiles shall cover all the cables and shall project minimum 80mm on either side of the cables.

Cables under road crossings and any surfaces subjected to heavy traffic, shall be protected by running them through RCC hume pipes of suitable size.

2.12 Excavations and Back Fill:

All excavations and back fill including timbering, shorting and pumping required for the installation of the cables shall be carried out by the Contractor in accordance with the drawings and requirements laid down elsewhere. Trenches shall be dug true to line and grades. Back fill for trenches shall be filled in layers not exceeding 150mm. Each layer shall be properly rammed and consolidated before laying the next layer. The Contractor shall restore all surfaces, roadways, side walks curbs, walls or other works cut by excavation to their original condition, satisfactory to the Owner/Consultant.

2.13 Markers and Warning Tape:

Approved CI cables markers shall be provided along the route of the cable at every 30M distance and at both ends of road crossing, indicating “H.V. Cables”. Special C.I markers shall be provided at all buried cable joints indicating “External Cable Joint”.
Warning tapes to be layed just above the cables before back filling.

2.14 Testing of Cables:

Prior to laying cables, following tests shall be carried out :

Insulation between phases and between phase and neutral/earth for each length of cables, before and after jointing.

For H.T Cables, high voltage test by applying 17kV (rms) for 11kV cables for 5 minutes between conductor and screen/armour earth.

On completion of cable laying work, the following tests shall be conducted in the presence of the Construction Manager.

Insulation Resistance Test (sectional and overall)

Continuity resistance test.

Sheathing continuity test.

Earth test.

Conductor resistance test.

Partial discharge test.

All tests shall be carried out in accordance with relevant Indian standard code of practice and Electricity Rules. The Contractor shall provided necessary instruments, equipment and labour for conducting the above tests and shall bear all expenses in connection with such tests.

2.15 Storing:

All cables shall be supplied in drums. On receipt of cables at site, the cables shall be inspected and stored in drums with flanges of the cable drum in vertical position. The end of the cable shall be sealed for water tightness.

2.16 Embossing:

The cables shall be embossed every 300mm along the length of the cable showing the voltage grade and the year of manufacture of the cables.

2.17 Measurement

Mode of measurement is as follows:

All power cables including fixing accessories as described in specifications and BOQ are measured in linear running meter (Rm).

Power cable terminations are measured in Number (No).as End termination.

2.18 ROAD CROSSINGS

All pipelines laid up to 1Mt below roads (FGL) or shall be taken through suitable underground trenches/ Hume pipe of suitable sizes. The size of trenches shall be as per the drawings.

3 CABLE TRAYS, RACE WAYS AND ACCESSORIES: -

The cable trays shall be complete with all necessary coupler plates, elbows, tees, bends, reducers, stiffeners, fatness and other accessories and hardware. All hardware (i.e. bolts, nuts, screws. washers, etc.) shall be hot dip galvanized in Open Area/ Pre galvanized for internal.

3.1 CABLE TRAYS - CONSTRUCTION NOTES

3.1.1 LADDER TYPE

A) Prefabricated factory assembled bolted rung type ladder type cable trays shall be made out of hot dip/Pre galvanized (Hot dip galvanized should be minimum of 40/50microns zinc coating) G.I.Sheated galvanized sheet steel & slotted rungs shall be complete with associated accessories such as coupler plates, tees, elbows etc., the trays shall be fabricated from Minimum 2 mm thick sheet steel. Cable tray covers shall be fabricated from 16 gauge perforated (1.60 mm thick) hot dip galvanized sheets (cover shall be provided if specified in the BOQ).

B) The cable trays shall be supplied in standard lengths of 2500 mm the cable tray should be 1250mm in size. and clear inside widths x height of trays shall be as follows:

Ladder type trays Sizes (mm):150 x 50mm, 300 x 50mm, 450 x 75mm, 600 x 75mm, 750 x 75mm and 1000 x 75mm /As per the requirement and approved construction drawings.

C) Cable trays, accessories and covers shall be hot tip galvanized/G.I.Type.

D) The spacing of rungs for ladder type of trays shall be Max of 300mm unless otherwise specified.

E) All finished cable trays and accessories shall be free from sharp edges, corners, burrs and unevenness.

F) All welded joints should be properly coated with Zinc paint.

3.1.2 PERFORATED TYPE

A) The perforated type cable trays shall be fabricated out of hot dip galvanized /Pre galvanized (Hot dip galvanized should be minimum of 40/50microns zinc coating)sheet steel, the associated accessories such as coupler plates, tees, elbows etc., shall be fabricated from 2mm thick for trays above 300mm, up to 300mm shall be with 1.6mm hot dip galvanized steel sheets. Cable tray covers shall be fabricated from 16 gauge perforated (1.60 mm thick) hot dip galvanized sheet steel (cover shall be provided if specified in the BOQ).

B) The cable trays shall be supplied in standard lengths of 2500 mm the cable tray should be in length of 1250mm in size and clear inside widths x height of trays shall be as follows:

Perforated type trays Sizes (mm) : 150 x 50mm, 300 x 50mm, 450 x 75mm, 600 x 75mm, 750 x 75mm and 1000 x 75mm/As per the requirement

C) Cable trays, accessories and covers shall be hot dip galvanized/G.I. Type.

D) All finished cable trays and accessories shall be free from sharp edges, corners, burrs and unevenness.

E) All welded joints should be proper coated with Zinc paint.

3.2 CABLE TRAYS - INSTALLATION NOTES

Cable trays shall be installed generally at the elevations shown in respective cable tray layout drawings. If any major modifications in the drawings are envisaged in the field, these should be carried out after getting approval from consultant.

Before laying the trays, contractor shall submit the shop drawing & take the approval from Client/ Consultant.

A) It shall be the responsibility of the electrical contractor to mark up all the field modifications on the latest issues of the drawings and return two copies of all such " as constructed " drawings to Client/ Consultant.

B) The type and size of tray to be used shall be as mentioned in the individual layout drawings.

C) The maximum size of cable tray when used in trenches shall be of 750 mm width.

D) Cable trays shall be welded to the mounting/ carrier structures. Trays shall be supported with suitable M.S.angle/ hi-tech rod supports/threaded rod with proper intervals.

E) Each continuous laid out length of cable tray shall be earthed at minimum two places by GI flats of minimum size 25x3 mm (unless otherwise noted) to the purchaser's earthing system. The distance between earthing points shall not exceed 10 meters.

F) The following shall be checked before laying the cables on trays.

a) Check for proper painting and identification nos. of the trays.
b) Check for continuity of cable trays over the entire route.
c) Check that all sharp corners, burrs and waste materials have been removed from the tray.

d) Obtain clearances from piping contractor/other agencies engineer that no piping will be taken in the way of cable trays.
e) Check for earth continuity & earth connection of cable trays.
f) Cable tray installation work shall comply with all currently applicable statutes, regulations and safety codes in the locality where the installation is to be carried out.

3.3 GI OPENABLE RACEWAYS

The openable raceways shall be made out of 1.6/2mm thick galvanized sheet steel. The top cover of raceways should be in 1.25mtr length/as specified in BOQ.

The cable raceways shall be complete with all necessary coupler plates, elbows, tees, bends, reducers, stiffeners and other accessories and hardware. All hardware (i.e. bolts, nuts, screws. washers, etc.)

It shall be used to lay in ceiling. It shall be complete with necessary hi-tech rod supports. There shall be junction boxes & top cover should be openable type for cable pulling/ laying etc.

The body all raceways shall be earthed using minimum 4Sq.mm copper flexible wires.

3.4 GI CONCEALED RACEWAYS

The concealed raceways shall be made out of 2mm thick galvanized sheet steel. Depth of the race way shall be 40mm (Welded type).

The cable raceways shall be complete with necessary floor boxes made out of 2mm thick hot dip /G.I. galvanized sheet steel. Height of the floor boxes shall be 45/50mm.

It shall be used to lay in floor. (There shall be any junction boxes & pull wire should be provided for cable pulling/ laying etc.)

The body all raceways shall be earthed using minimum 4Sq.mm copper flexible wires.

3.5 GI VERTICAL RACEWAYS

The vertical raceways shall be made out of 2mm (Specified in drawing or Boq) thick galvanized sheet steel. The top cover of raceways should be in 1.25-1.5 mtr. length. GI supports for binding cables shall be provided at an interval of 1000/1250/1500mm

The cable raceways shall be complete with all necessary coupler plates, elbows, tees, bends, reducers, stiffeners and other accessories and hardware (i.e. bolts, nuts, screws. washers, etc.)

It shall be used to lay in vertical shaft to connecting hub rooms & server rooms. It shall be complete with necessary hi-tech rod supports. There shall be junction boxes & top cover should be openable type for cable pulling/ laying etc.

The body all raceways shall be earthed using minimum 4Sq.mm copper flexible wires.

3.6 RACEWAYS - INSTALLATION NOTES

The raceways shall be installed generally as per the raceway layout drawings. If any major modifications in the drawings are envisaged in the field, these should be carried out after getting approval.
Before laying the raceways, contractor shall submit the shop drawing & take the approval from consultant. Race way should be fixed with proper suitable fastners.

Note:

The raceways which have to be laid in the floor shall be laid before doing the floor screeding & if it has to be done after screeding, it shall be done with floor cutting machine with necessary accessories & tools. After laying the raceways, the contractor shall be responsible for plastering/ finishing the floor with cement concrete.

4 POWER & LIGHTING DISTRIBUTION BOARDS: -

4.1 Distribution boards shall be suitable for 415 volts, 3 phase A.C. supply & of 230 volts single phase A.C. supply as required. Distribution board shall generally conform IS: 2675 or BS: 214. All the Distribution Boards shall be Phase Segregated in Combination of MCB & RCCB. Three Phase Incoming will be MCB, Per Phase Isolation will be DP RCCB, and Outgoing will be SP MCB's.Voltage surge suppressor used in all incomers of UPS DBs.

4.2Type & Construction:

Distribution boards shall be of totally enclosed dead front safety type. The enclosures shall be made of the best quality sheet steel of not less than 1.6 mm. The sheet steel shall be treated with a rigorous rust inhibition process before fabrication. The distribution boards shall comprise of switch fuse unit or miniature circuit breakers as incoming and required number of circuit breakers as out goings. The main and out goings shall have rating as specified in the drawings and schedule. The distribution board shall be provided with suitable earthing lug.
Neutral link & Earth link bus bars & Enclosure should be Min.IP 43 Protection & Double door system

4.3 Bus Bars:

Suitable bus bars made of high conductivity Copper strips and mounted on non-hydroscopic insulating supports shall be provided. Separate earth line will be provided.

4.4 Circuit Breakers:

Miniature circuit breakers shall be of approved design and make. Circuit breakers shall be equipped with individually insulated, braced and protected connectors. The front fact of all the breakers shall be flush with each other.

4.5 Safety & Interlocks:

All the live parts shall be shrouded such that accidental contacts with live parts are totally avoided. Distribution boards shall be provided with a front hinged Double door. Distribution boards interior assembly shall be dead front with the front cover removed. Main lugs shall be shrouded. Suitable insulating barrier made of arc resistant material shall be provided for phase separation. Ends of the bus structures shall also be shrouded.

4.6 Cabinet design:

The distribution board cabinet shall be totally enclosed type with dust and vermin proof construction. The cabinet shall be stove enameled. The interior surface shall be finished to an off-white shade. Over this, a cover made of stove enameled sheet shall be provided with slots for operating handle of breakers. The cabinet shall be equipped with a front door having a spring latch and vault lock. Cabinets shall have detachable gland plates at both top and bottom. Neutral link & Earth link bus bars & Enclosure should be Min.IP 43 Protection & Double door system.

4.7 Terminals:

Distribution boards shall be provided with terminals of adequate size to receive mains and outgoing circuits. The location of the terminal block shall be so located that crowding of wires in the proximity of live parts is avoided.A neutral link having rating equal to that phase bus shall be provided.

4.8 Directory:

Distribution boards shall be provided with a directory indicating the area or loads served by each circuit breaker, the rating of breakers, size of conductors, etc. The directory shall be mounted in metal holder with a clear plastic sheet on inside surface of the front door.

4.9 Installation:

Distribution boards shall be surface mounted/ recessed mounted as required by the EIC/ Architects and at the locations shown on the drawings. The boards shall be fixed with suitable angle iron clamps and bolts. All the cables/ conduits shall be properly terminated using gland/ grips/ check nuts etc. Wiring shall be terminated properly using crimping lugs, sockets & PVC identification as per rules.

4.10 Testing:

Distribution boards shall be tested at factory as per IS:3675 or CS: 214.The tests shall include insulation test etc. Distribution board shall be tested for insulation resistance after the erection.

5 CONDUITS, WIRING & ACCESSORIES FOR INTERNAL WORK:-

5.0 WIRING, SWITCHES, SOCKETS AND ACCESSORIES

5.1 GENERAL REQUIREMENTS

Light control switches shall be of modular type, 240V,6/10A rating for controlling light points as specified. Light control switches shall be of plate type design with metal or PVC boxes suitable for flush mounting for general lighting. Light control switch boxes shall be of metal or PVC as specified.

All sockets 6A and 16 A ratings shall be of flush mounting type (unless otherwise indicated with control switches of plate type design of the same rating as that of the sockets. All socket outlets shall be of 3 pin type with PVC/ metal boxes.

5.2 INDUSTRIAL TYPE PLUG & SOCKETS

Industrial type sockets shall be provided wherever specifically called for on the drawings. Industrial sockets shall be rated as specified. Plugs and sockets shall have 3 pins for single phase applications and 5 pins for 3 phase applications. The sockets shall be provided with suitable plug top and cable entry device and shall be controlled by a suitably rated rotary switch/MCB. The sockets shall be housed in suitable PVC housings of IP 54/66 protection class for out door application.

5.3 LIGHT OUTLET ACCESSORIES

Accessories for light outlets shall be in conformity with requirements of relevant 'IS' specification. Only approved make of accessories shall be supplied.

5.4 INSTALLATION

All switch connections shall be made only after ensuring the continuity of wires and terminations. Tapping of wires shall be done only at the terminals of switches, sockets

and ceiling roofs and terminal blocks. Under joining and extension of wires in pipes and conduits shall not be carried out under any circumstances.

The arrangement of switches and sockets shall be neat, systematic, and aesthetic. The Contractor shall obtain approval from the EIC/CLIENT/ CONSULTANTS/ARCHITECT with regard to the proper location of switches and all outlets.

The enclosures of sockets and pin of the sockets shall be connected to the ground through a proper size insulated earth continuity wire. Metal or FRP phase barriers shall be interposed between switches located in a common enclosure, when wired on different phases.

The installation of light fixtures shall include suitable chain support for light fixtures from ceiling & also suitable terminal blocks for termination.

It is preferable that not more than two wires shall be terminated on any terminal for better grip.

5.5 SUB-MAINS AND CIRCUIT MAINS

Circuit mains starts from DBs to Switch box & loops to other switch boxes

Wiring of sub-mains and circuit mains in concealed or surface conduit systems shall be with 2mm thick rigid PVC-FRLS and conduit accessories with 1100V grade PVC-ZHFR/FRLS insulated as per IS694, multi strand copper flexible wires for phase, neutral and earth. Sub-main shall include GI or PVC draw-boxes, sized as required being located at every floor for easy drawing of wires. FRLS PVC heavy duty conduits shall be considered wherever the open conduiting system prevails with suitable fixing arrangement.

Wherever necessary the contractor shall do the chipping works for laying the conduits & plastering work for finishing.

All wires laid in raceways shall be neatly bunched circuit wise for easy identification of cables. Wherever possible all the conduits & raceways shall be earthed using copper wire.

5.6 POINT WIRING

Point wiring shall commence from the first point control box for the points connected to the same circuit. Point wiring for lights, sockets etc, and shall be carried out with PVC ZHFR/FRLS insulated multi strand copper conductor wires of 1100V grade. The point wiring shall be inclusive of suitably sized conduits of standard and approved make (as specified before) along with approved quality of conduit accessories and shall be provided with PVC insulated copper earth continuity wire for earthing 3rd pin of sockets at all points as specified.

Wiring of light points and 6/10A switched socket outlets by providing PVC or rigid MS Box with accessories, and 2.5/ 1.5 Sq.mm 1100V grade PVC ZHFR/FRLS flexible multi strand copper wires, SP Switch 6/10A modular plate switch, and other point wiring accessories and carrying out surface/ concealed conduit point wiring. All light points, 5A sockets shall be earthed using the third core of green colour insulated copper wires.

FRLS PVC heavy duty conduits shall be considered wherever the open conduiting system prevails.
with suitable fixing arrangement

Light point shall be provided with suitable terminals for looping & termination, suspended light fixtures shall be provided with suitable length of metal chain/rope.

The wiring shall be complete in looping system.

Each circuit wiring shall be provided with suitable copper earth continuity conductor. Not more than eight light points/ fan points shall be grouped on one lighting circuit. The load per circuit shall not exceed 750 watts. All the wiring shall be carried out in looping-in-loop system.

The maximum number of various size conductors that could be drawn into various sizes of conduits shall be as per table II of IS: 732 (Latest Edition). The wiring shall be colour coded for easy identification of phases and neutral the following colour codes shall be adopted:

RED	YELLOW	BLUE	BLACK	GREEN
Phase			**Neutral**	**Earth**

All circuit wiring shall be provided with printed PVC identification ferrules at either end bearing the circuit number and designation.

PVC Flexible conduit shall be used for dropping from ceiling complete with couplings for dropping circuits and point wiring for connecting up the lighting fixture.

5.7 WORKSTATION WIRING

For each computer 2 Nos of 6A 3pin socket controlled by 1 Nos of 6A switch & 1 Nos of 6A 3pin socket controlled by 1 No of 6A switch in 8 modules Plate shall be provide. Third pin of each socket outlet shall be connected to the earth. 13A Universal sockets shall be considered for all cabins & Meeting rooms. For Access Ctrl Panel provide 1 data & 1 UPS socket ctrl by 1 6A switch. For IP Camera & Wire less LAN 1 data & 1 UPS socket with out switch in ceiling shall be provide

5.9 LABELING

The Contractor shall provide labeling for all light control switches, industrial-type sockets, socket outlets, permanently connected devices, etc, identifying the distribution board and circuit breaker number, in an approved manner, acceptable to the Client/ Consultants, to provide ready identification. Hand painted labels are not acceptable.

5.10 TESTING OF ELECTRICAL INSTALLATIONS:

5.10.1 Testing of installation shall be as per IS: 732-1963.

a) The insulation resistance shall be measured by applying suitable pressure between earth and whole system of conductors or any section thereof with all fuses in places and all switches closed and except in earthed concentric wiring all lamps in position or both poles of the installation otherwise electrically connected together, where a direct current pressure of not less than twice the working pressure provided that it does not exceed 500 volts for Medium Voltage circuits. Where the supply is derived from the three wire (A.C. or D.C.) or a poly phase system, the neutral pole of switch is connected to earth either direct or through added resistance, the working pressure shall be deemed to be that which is maintained between the outer or phase conductor and the neutral.

b) The insulation resistance measured as above shall not be less than 50 mega ohms divided by the number of points on the circuits, provided that the whole installation shall be required to have an insulation resistance greater than one mega ohm.

c) Control rheostats, heating and power appliances and electric signs , if required, be disconnected from the circuit during the test but in the event of the insulation resistance between the case or frame work and all live parts of each rheostat appliances and sign shall not be less than that specified in relevant Indian Standard Specifications or where there is no such specification shall not be less than a half mega ohm.

d) The insulation resistance shall also be measured between all conductors connected to one pole or phase conductor of the supply and all the conductors connected to the middle wire or the neutral or to the other pole or phase conductors of the supply and its value shall not be less than specified in sub clause (b).

5.10.2 Testing of Earth continuity path:

The earth continuity conductor including metal conduits and metallic envelopes in all cases shall be tested for electric continuity and the electrical resistance of the same along with the earthing lead but excluding any added resistance or leakage circuit-breaker measured from the

connection with the earth electrodes to any point in the earth continuity conductor in the completed installation shall not exceed one mega ohm.

5.10.3 Testing of polarity of non-linked single pole switches:

a) In a two wire installation, test shall be made to verify that all non-linked single pole switches have been fitted in the same conductor throughout and such conductor shall be labeled or marked for connection to an outer or phase conductor or to the non-earthed conductor of the supply.

b) In a three wire or a four wire installation, a test shall be made to verify that every non-linked single pole switch is fitted in conductor which is labeled or marked for connection to one of the outer phase conductors of the supply.

5.11 TABLE - MAXIMUM PERMISSIBLE NUMBER OF 1.1 KV GRADE SINGLE–CORE CABLES THAT MAY BE DRAWN INTO RIGID NON-METALLIC CONDUITS

Size Of Cable		**Size of Conduit, mm**					
Nominal Cross Sectional Area in mm2	**Number & Diameter (in mm) of wires**	**16**	**20**	**25**	**32**	**40**	**50**
		Number of Cables (Max.)					
1.0	1/1.12*	5	7	13	20	--	--
1.5	1/1.40	4	6	10	14	--	--
2.5	1/1.80	3	5	10	14	--	--
4	1/2.24	2	3	6	10	14	--
	7/0.85*						
6	1/2.80	--	2	5	9	11	--
	7/1.40*						
10	1/3.55+	--	--	4	7	9	--
	7/1.40*						
16	7/1.70	--	--	2	4	5	12
25	7/2.24	--	--	--	2	2	6
35	7/2.50	--	--	--	--	2	5
50	7/3.00+	--	--	--	--	2	5
	19/1.80	--	--	--	--	2	3

*** For copper conductors only. + For aluminium conductors only.**

No. of strands in multi strand single core copper wiring cables

Sl.no.	Size (Sq.mm)	No. Of strands/Dia of each strand (mm)
1.	1.0	14/0.3
2.	1.5	22/0.3
3.	2.5	36/0.3
4.	4	56/0.3
5.	6	84/0.3
6.	10	140/0.3

6 CONDUITS FOR COMMUNICATION & DATA SYSTEM: -

1. The conduits for the Data System shall be same as explained and specified elsewhere for other work. The minimum size of conduits used for Data System shall be of 20 mm dia.

2. All distribution boxes shall be flush mounting, flat fronted, 16 Gauge sheet steel enclosed boxes flush with wall and properly joined to conduits. The distribution boxes shall incorporate terminal strips of the combined soldering screw type/tag blocks as required.

3. The data outlet boxes made of 16 Gauge sheet steel shall be of minimum 75 x 75 x 50 mm. These shall be flush mounting type installed with an approved cover matching with all other outlets in the electrical system and consisting of a CAT6 RJ 45 outlet and approved by the structured data and communication cabling system.

4. The data boxes shall be generally mounted at 450/300mm unless otherwise specified/indicated in drawing.

5. The contractor shall consult and co-operate with the telephone department when installing the data wiring and conduit system and shall abide by their requirements, rules and regulations, shall furnish all work and material to secure their approval of the completed installation.

6. Detailed drawings showing the data terminal and junction boxes fabricated in accordance with above requirements shall be submitted by the contractor for approval to the EIC.

7. Rates shall include a GI fish wire left in the conduit to draw data wires. The end of conduit shall be sealed to prevent dirt, dust, mortar or any foreign matter going into telephone conduits.

8. The data indoor wires shall be 0.5 mm annealed tinned copper conductor, PVC insulated, twisted into pairs, laid up, taped and overall PVC sheathed, or CAT 6# UTP/STP cable.

9. The data outdoor cable shall be 0.5 mm annealed copper conductor, polythene insulated, colour coded, twisted into pairs, laid up, jelly filled with petroleum jelly compound, wrapped with non-hygroscopic tape under moisture barrier poly-al-laminated foil tape and embedded with water proof polythene material.

7 LIGHT FITTING AND ACCESSORIES: -

1.0 SCOPE:

This Specification also covers the design, material specification, manufacture, testing at works, inspection and delivery at site of light fittings and their associated accessories.

2.0 STANDARDS:

The light fittings and their associated accessories such as lamps/tubes, reflector, housings, electronic ballasts/control gears etc. shall comply with the latest applicable standards. All luminaries, lamps and accessories shall be of same make.

3.0 GENERAL REQUIREMENTS:

Fittings shall be designed for continuous trouble-free operation under hot humid atmospheric conditions, at an ambient of 45^{o}C without reduction in lamp lift or without deterioration of materials and internal wiring. Outdoor fittings shall be weatherproof and waterproof type.

The fittings shall be designed so as to facilitate easy maintenance, including cleaning, replacement of lamps/starters etc.Connectors between different components shall be made in such a way that they will not work loose by small vibration.

For each type of light fitting, the Manufacturer/Vendor shall supply the utilization factor to indicate the proportion of the light emitted by the bare lamp which falls on the working plane.

The fittings shall be supplied complete with lamps.The fittings and accessories shall be designed to have low temperature rise. The temperature rise above the ambient temperature shall be as indicated in the relevant Standards.

All Sodium vapour, Mercury vapour and Metal Halide fittings shall be completed with accessories like lamps, ballasts, power factor improvement capacitors, starters/Ignitors wherever applicable etc. These shall be mounted as far as possible in the fitting assembly only. If these cannot be accommodated inside, then a separate metal enclosed box shall be included to accommodate the accessories and in addition with a fuse and a terminal block suitable for loop-in, loop-out connections by 1100V Grade FRLS PVC insulated wires upto 4 Sqmm.

Outdoor type fittings shall be provided with outdoor type Control gear box. The fittings shall be power factor corrected to 0.95 (maximum)

Each fitting shall have a terminal block suitable for loop-in, loop-out T-off connection. The internal wiring shall be completed by the manufacturer by means of stranded Copper wire and terminated on the terminal block.All hardware used in the luminaries, shall be Cadmium plated.

4.0 EARTHING:

Each light fitting shall be provided with an earthing terminal suitable for connection to the earthing conductor.

All metal or metal-enclosed parts of the housing shall be bonded to the earthing terminal so as to ensure satisfactory earth continuity throughout the fixture.

5.0 PAINTING/FINISH:

All surfaces of the fittings shall be thoroughly cleaned and de-greased. The fittings shall be free from scale, sharp edges and burns.

The housing shall be stove-enameled/epoxy stove-enameled/vitreous enameled powder-coated of anodized as indicated as indicated under various types of fitting.

The finish of the fitting shall be such that no bright spots are produced either by direct light source or by reflection.

6.0 ACCESSORIES FOR LIGHT FITTINGS:

6.1 Reflectors:

The reflectors shall be made of CRCA sheet steel. Aluminium/Silvered glass as indicated, for the above mentioned fittings.

The thickness of Steel/Aluminium, shall comply with relevant Standards. Reflectors made of Steel, shall have stove-enameled/ Vitreous-enameled/ Epoxy-coating finish.

Aluminium used for reflectors, shall be anodized/Epoxy Stove-enameled/ Mirror polished.

Reflectors shall be free from scratches or blisters and shall have a smooth and glossy surface having an optimum light reflecting co-efficient such as to ensure the overall light output specified by the manufacturer.

Reflectors shall be readily removable from the housing for cleaning and maintenance without disturbing the lamps and without the use of tools; they shall be securely fixed to the housing by means of positive fastening device of captive type.

6.2 **LAMP HOLDERS:**

Lamp Holders shall comply with relevant Standards. They shall have low contact resistance, shall be resistant to wear and shall be suitable for operation at the specified temperature without deterioration in insulation value. They shall hold the lamps in position under normal condition of shock and vibration met within normal installation and use.
Lamp Holder for the fluorescent lamps shall be of the spring loaded bi-pin rotor type. Live parts of the lamp holder shall not be exposed during insertion or removal of the lamp or after lamp has been taken out. The lamp holder contacts shall provide adequate pressure on the lamp cap pings when in working position.

Lamp Holder for incandescent, Mercury Vapour and Metal Halide lamps shall be of bayonet type upto 100W and Edison Screw (E.S) type Haher Wattages.

Starter holders for fluorescent lamps shall conform to the relevant Standards. All material used in the construction of the holder shall be suitable for tropical use.

The Starter Holder shall be so designed that they are mechanically robust and free from any operational difficulties. They shall be capable of withstanding the shocks met within normal transit, installation and use.

6.3 **BALLASTS:**

The ballasts shall be designed, manufactured and supplied in accordance with the relevant Standards. The ballasts shall be designed to have a long service life and low power loss.

Ballasts shall be mounted using sell locking, anti-vibration fixings and shall be easy to remove without de-mounting the fittings. They shall be in dust-tight, non-combustible enclosures.

The ballasts shall be of the inductive, heavy-duty type, filled with thermosetting insulating, moisture-repellant, Polyester compound filled under vacuum. Ballasts shall be provided with tapping to set the voltage within the range specified. End connections and taps shall be brought out in a suitable terminal block, rigidly fixed to the ballast enclosure. The ballast wiring shall be of Copper wire that shall be free from

hum. Ballasts which produce humming sound shall be replaced free of cost by the Vendor.

Low loss Silicon steel lamination, shall be wounded with super enameled Copper wire with Class "F" insulation on glass filled Nylon bobbin.

High temperature-resistant interlayer Polyester film shall be used for inter layer insulator glass-filled Polyester connector should withstand high voltage upto 5 KV.

Separate ballast for each lamp shall be provided in case of multi lamp fittings.

The ballast for each lamp shall be provided in case of multi lamp fittings.

The ballasts for Metal Halide lamps shall not be constant wattage type.

6.4 **LAMPS:**

The fluorescent lamps shall have a high lumen output of 3250 lumens. The lamp shall have triple coil electrode with an anode ring and a triband Phospher coating.

Mercury Vapour lamps shall be of high pressure, colour corrected type, with a luminous efficiency of 50 lumen/watt. The discharge tube shall be made of high grade quartz.

Sodium Vapour Lamp are of high pressure type.

Metal Halide lamps shall be provided with internal diffuse coating and the average lumen output shall be 19000 lumen for 250W and 32000 lumen and the lamp voltage shall not exceed 100V for 250W and 128 V for 400W. The colour-rendering index of the lamp shall be 93. The lamp shall be suitable for universal burning position and for use in open type luminaries. The lamps shall be suitable for operating on a Sodium Vapour Control gear.

The lamps shall be capable of withstanding small vibrations and the connections at lead in wires and filaments/electrodes, shall not break under such circumstances.

Lamps/Tubes shall conform to relevant Standards and shall be suitable for supply voltage and frequency specified.

8 LIGHTNING PROTECTION SYSTEM.:-

EXTERNAL/INTEGRATED LIGHTNING PROTECTION SYSTEM AS PER INDIAN STANDARDS IS/IEC 62305-3 & NBC-2016

General

There are no devices or methods capable of modifying the natural weather phenomena to the extent that they can prevent lightning discharges. Lightning flashes to, or nearby, structures (or lines connected to the structures) are hazardous to the structures, their contents and installations as well as to lines. Therefore, lightning protection measures are essential

Lightning Protection System shall be in accordance with IS IEC 62305-3 & NBC-2016. Lightning Protection consists of external Protection for the building with Air termination, Down Conductors and Earthing and Internal protection for power lines with Surge Protective devices.

Generally lightning between cloud and ground creates failures. How ever inter-cloud and intra-could lightning also can create potential differences and failures in electronic installation. More than 95 % of Lightning strikes are of Negative impulse and less than 5 % are of positive impulse. Positive impulses are mainly due to dry lightning in cold areas.

Current parameters as per IS/IEC 62305 and the effects of lightning are as below

Current Parameters	Symbol	Unit	Lightning Protection Level				Effect
			I	II	III	IV	
First positive Impulse							
Peak Current	I	kA	200	150	100		Mechanical
Impulse charge	Q_{SHORT}	C	100	75	50		Thermal (arc)
Specific Energy	W / R	MJ/Ω	10	5.6	2.5		Mechanical & Thermal
Average Steepness	d_i / d_t	kA / µS	20	15	10		Surges and flashover
Time Parameters	T_1 / T_2	µS / µS	10/350				
First Negative Impulse							
Peak Current	I	kA	100	75	50		Mechanical
Average Steepness	d_i / d_t	kA / µS	100	75	50		Surges and flashover
Time Parameters	T_1 / T_2	µS / µS	1 / 200				

Damages from lightning strike are due to Peak Current (I), Charge (C), Specific Energy (W/R) & Rate of change of current (di/dt). Lightning protection is designed to take care of these effects of lightning and hence the following parameters shall be strictly followed.

Effect of Lightning on External LPS (Air termination, Down Conductor and Earthing)

Effects on air-termination systems arise from both mechanical and thermal effects. Effects on down-conductors are thermal effects due to resistive heating & mechanical effects in parallel conductors and in Bends. The real problems with earth-termination electrodes are linked with chemical corrosion and mechanical damage caused by forces other than electro dynamic forces.

Sizing and fixing of Materials are selected to handle the mechanical and thermal effects. Bends in down conductor shall strictly NOT be at 90 degree (right angles) & should have a curved path of 45-degree bend. Earth electrodes are selected based on the current handling capacity up to 1 second. To avoid corrosion problems as explained in IS/IEC 62305 (**clause E.4.3.4 and E.5.4.3.2**), GI is strictly not recommended inside concrete and in soil.

Effect of Lightning on Internal LPS (SPD's for POWER, DATA lines etc.)

Effect on internal LPS is mainly due to coupling and the rate of change of current. Due to Very high d_i/d_t of the first negative stroke. The expected problem is the response time of SPD and the voltage drop in the connecting wires. SPD's at the incoming panels shall have a response time less than 1 nano sec & shall be of BUSBAR Mounted type to avoid connecting wire length.

LPL (Lightning Protection Level)

LPL is a number associated with a set of lightning current parameters relevant to the probability that the associated minimum & maximum values do not exceed the normally occurring lightning. LPL can be determined by Risk analysis as explained in IS IEC 62305-2 or can be selected based on the guideline in NBC-2016.

Application	LPL*
Computer Data Centers, Military Applications, Nuclear Power Stations, High raise Hotels/Hospitals, airports, essential services such as telecom towers	1
EX-Zones in the industry and chemical sector, Low raise Hospitals & Hotels, fuel retail outlets, gas station, compressor station etc	2
Schools, Banks, Residential Buildings, Temple, Churches, Mosques	3/4

LPL levels, probability and basic design consideration:

Class of LPS	Lightning current MINIMUM	Lightning current MAXIMUM	Interception probability	Rolling sphere radius (m)	Mesh size (m)	Down Conductor Spacing
1	3 kA	200 kA	98%	20	5*5	10
2	5 kA	150 kA	95%	30	10*10	10
3	10 kA	100 kA	88%	45	15*15	15
4	16 kA	100 kA	81%	60	20*20	20

Protection angle w.r.t Height

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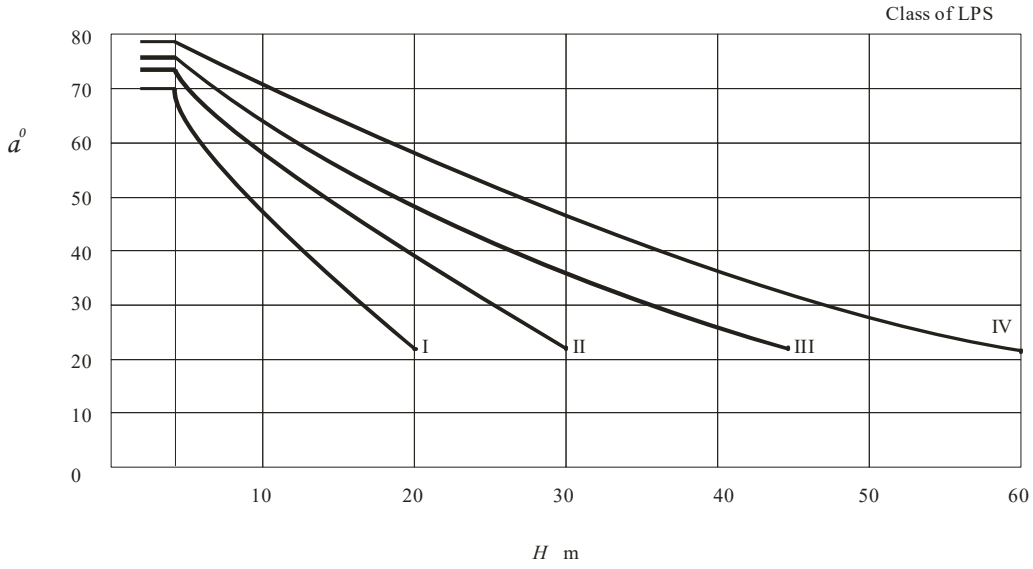

Air termination system:

Material, Configuration and Minimum cross-sectional area of air terminal & down conductors

Air Termination mesh conductor and down conductors: 8 mm Aluminium alloy round conductor (50 mm^2)
Air Termination Rod: 10 mm, 16 mm & 40 mm solid Aluminium rods (combination of sizes) (tubes are not allowed)

Joints / Connectors / Fixing materials:

Connection materials	Connector type	GI fixing materials shall not be used
Aluminium to Aluminium	Aluminium or SS	
Aluminium to Steel	SS	

Aluminium accessories if connection is between Aluminium materials are necessary. SS accessories if connections are between aluminium and copper / copper coated materials.
Earth Termination Conductor: 10 mm solid copper coated steel conductor (100 microns min coating)
Earth Termination Joints in soil: Exothermic welding
GI material for earthing shall not be used as per the recommendation in IS/IEC62305 & NBC 2016

Air termination system: Air termination system (Horizontal/Vertical) in the roof shall be according to Lightning Protection Level specified in NBC 2016. The air termination system consisting of vertical rods and/or mesh shall be connected to the structural conductor through earth studs provided at the parapet / columns of the building. For this purpose, enough earth studs with provision of mechanically strong connection need to be provided at the parapet / wall / column at the top of the building. Air termination system shall be installed strictly after completion of the installation of all roof mounted electrical / metal installations.

For building with metal roof, the air terminal shall be directly connected to the steel roofing sheet with special leak proof screws. Bonding of roof steel and structural support columns shall be ensured by installing braided wires at every 10 meters

If the structure height is more than 60 meters, top 20% of the height of the structure shall be protected with a lateral air termination system. This is needed because the probability of flashes to the side is generally more for structures more than 60 meters in height. More importance needs to be provided to Corners, Edges and significant protrusions such as balconies. Metallic handrails/ Aluminium frame of wall cladding if used in balconies shall be conned to air termination / down conductors.

In PEB / Steel buildings where GI sheet roofing, air termination mesh / Rod shall be directly mounted on the sheet. Fixing materials used shall be in good electrical contact with the sheet, shall not create water leakage.

No drilling is allowed in the terrace for fixing the air terminal, if the roof is made of concrete. Parapet wall is exception to this.

Air terminal holder:

Concrete Roof structure: Conductors shall be securely fixed on the terrace by means of concrete air terminal holders with suitable fixing materials which is fixed on the roof by adhesive or cement mortar taking care of varying weather conditions. Plastic air termination conductor holder is not allowed. The minimum height of this air terminal holder shall be 50 mm to avoid the contact of conductor with water

Metal Roof structure: Conductors shall be securely fixed on the terrace by means of air terminal holder which is fixed on the roof by metal conductor holder made of Stainless steel. As metal roof structures are normally tapered at an angle, there are no min height criteria for metal conductor holder.

Recommended fixing distance of air terminal and down conductors

Arrangement	Recommended distance	
	TAPE / Strip	ROUND
Horizontal conductor on horizontal surface	500 mm	1000 mm
Horizontal conductor on vertical surface	500 mm	1000 mm
Vertical conductor from Ground to 20 height	1000 mm	1000 mm
Vertical conductor above 20m height	500 mm	1000 mm

If antenna, Chillers or any other roof top electrical equipment is present in terrace, the same must be protected by using vertical air terminal after calculating the safety or separation distance. The vertical air terminal must have suitable supports to hold it. Wind speed need to be considered. Vertical air terminal must be connected to horizontal air terminal by using suitable connectors.

At the crossings of the horizontal air terminals, suitable Cross connector must be used.

Safety or Separation distance: (not required for LPS using structural natural components)
To avoid flash over to electrical/electronic apparatus, this equipment shall be kept at a distance away from LPS components more than the safety distance as per the following calculation.

Safety/Separation distance (S) in m = (Ki * kc*L) / km

Coefficient ki depends on class of LPL/LPS (ki = 0.08 for LPL1, 0.06 for LPL 2, 0.04 for LPL3 and 4)
Coefficient kc depends on no of down conductors: kc = 0.66 for 2 down conductors, kc = 0.44 for 3 or more down conductors
Value of coefficient km = 1
Value of L is the total distance between the equipment to be protected (for e.g. Antenna) to the equi-potential bonding bar situated just above the ground.

Expansion piece
In order to take care, the expansion of the metal in summer and contraction of the metal in winter, expansion piece with suitable connectors must be used at every 20m distance of horizontal air termination mesh.

Joints and Bends
The lightning protective system shall have few joints as far as possible & air terminal & down conductor must be straight. Where it is not possible, it should NOT be bent at 90 degree (right angles) & should have a curved path of 45-degree bend.

Down conductor system
In order to reduce the probability of damage to electronic/electrical equipment, the down conductors shall be arranged in equi distance in such a way that from the point of strike to earth, several parallel current paths should exist & length of the current path should be minimum**.** Down conductors should be installed at each exposed corner of the structure as a minimum. Maximum distance between down conductors shall be as per the table above.

The dedicated copper coated 10 mm solid round conductor shall run inside columns on the periphery of the building and must be connected to the reinforced steel available in the columns will serve the purpose of down conductor for lightning protection in every floor of a multi-storeyed building. If the distance between 2 columns are lesser than 5-meter, alternate columns shall be selected to route the down conductors. If the distance is more than 10 meters, all the columns shall be used for down conductor routing.

Provisions for interconnection of metal frame of wall cladding shall be provided at every 5 meters in vertical and horizontal sections based on the architectural design. Training for making this interconnection shall be provided to facade supplier / installer

Testing of Down Conductor: Structural earthing used as a part of lightning protection system, overall resistance shall not be more than 0.2 ohm when measured between the air termination and the earthing test point provided at the ground level.

Test joints:
At the connection to the earth conductor, a test joint should be fitted on each down conductor at a height of 1 m from the ground, except in the case of natural down conductors combined with foundation earth electrode. The purpose of test joint is to measure the earth resistance value. The remaining portion of down conductor (i.e., after the test joint should be mounted inside a plastic pipe of minimum 3 mm thickness.)

Earth Terminations
For earth termination system, 2 basic types of earth electrode arrangements are applicable. Type A & Type B arrangement.

Type A arrangement: Comprises of horizontal or vertical earth electrode installed outside the structure to be protected connected to each down conductor. Minimum Length of vertical earth electrode shall be as below

Class of LPS	Typical Length of each vertical earth electrode based on Soil resistivity			
	Up to 500 Ω M	1000 Ω M	2000 Ω M	3000 Ω M
1	2.5 meter	10 meters	25 meters	40 meters
2	2.5 meter	5 meters	15 meters	22 meters
3	2.5 meter	2.5 meter	2.5 meter	2.5 meter
4	2.5 meter	2.5 meter	2.5 meter	2.5 meter

If horizontal electrodes are used, the length shall be double. In type A arrangement, the total number of earth electrodes shall not be less than two. Type A arrangement is suitable in places where electronic equipment is not located.

Type B arrangement: This type of arrangement comprises either a ring conductor external to the structure to be protected, in contact with the soil for at least 80% of its total length or a foundation earth electrode. Ring earthing must be 1 meter away from the building and 0.5m below the ground as a closed loop. Such earth electrodes can also be meshed. For structures with extensive electronic systems or with high risk of fire, type B earthing is most preferable method. There is no limit in the resistance of Ring Earthing if the ring radius of the ring is larger than 50 meters or 80 meters for LPL 1 and 2. For LPL 3 and 4 this radius is about 5 meters. The overall resistance of earthing system shall not exceed 10 ohms.

Galvanised steel (GI) as earthing material shall not be used.

Lightning Counters: At least 2 down conductors in an installation shall have a lightning counter tested as per IEC 62561. The counter shall be digital type with replaceable battery. Battery life shall be minimum 3 years. The minimum measuring current is 1KA (8/20) and the maximum is 100 KA (10/350). The counter shall be outdoor type, IP65 and shall be able to record date, time and no of strikes.

Quality and Confirmations

All materials and accessories shall be tested as per IEC 62561 for its mechanical / corrosion resistant / electrical conductivity. Vendor shall provide test reports along with completion certificate. GI (Hot dip galvanised or zinc electroplated) fixing materials and fasteners are not allowed.

References:

IS/IEC62305 – PROTECTION AGAINST LIGHTNING:

Part 1: General Principles
Part 2: Risk Management
Part 3: Protection of structures
Part 4: Protection of Electrical & Electronic equipment within structure
NBC-2016: National Building Code of India – 2016
IS3043: 1987: Code of practice for earthing.

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prior approval by the specifying engineer or manufacturer of the lightning protection system.

9 EARTHING SYSTEM:-

1. GENERAL

1.1 The earthing materials shall generally confirms to IS 3043 - 1987

1.2 The minimum thickness of earthing electrode shall not be less than 6mm. The minimum thickness of earth wires used in circuit / point wiring shall not be less than 1sqmm. The galvanized coating shall not be less than 700gms/sqmeter.

1.3 All non-current carrying metal parts of the electrical installation shall be earthed as per IS:3043 and with subsequent amendments.

1.4 All metal conduits, turnings, cable sheathes, switchgear, distribution boards, meters, light fixtures, fans and all other metal parts forming part of the work shall be bonded together and connected by two separate and distinct conductors to earth electrodes. Earthing shall also be unconformity with the provisions of rules 32, 61, 67 and 68 of IER-1956.

2. EARTHING CONDUCTORS

All earthing conductors shall be of high conductivity copper or GI as required/ specified and shall be protected against mechanical damage and corrosion. The connection of earth continuity conductors to earth bus and earth electrode shall be strong and sound and shall be easily accessible. The earth conductors shall be

rigidly fixed to the walls, cable trenches, cable trays or conduits and cables by using suitable clamps.

2.1 Main earth bus shall be taken from the main medium voltage panel to the earth electrodes. The number of electrodes required shall be arrived at taking in to consideration the anticipated fault on the medium voltage network.

2.2 All the sub-mains and sub-circuits shall be provided with earth continuity conductors as specified and connected to the main earth bus. Earthing conductors for equipment shall be run from the exposed metal surface of the equipments and connected to a suitable point on the sub-main or main earthing bus. All switch boards, distribution boards and isolators, disconnect switches shall be connected to the earth bus. Earthing conductors shall be terminated at the equipment using suitable lugs, bolts, washers and nuts. All conduits, cable armouring, raceways, rising mains, metal boxes, panel boards etc., shall be connected to the earth all along their run by earthing conductors of suitable cross sectional area. (Sprinkler pipes, water pipes, steel structural elements), lighting conductors shall not be used as a means of earthing an installation. The electrical resistance of earthing conductors shall be low enough to permit the passage of fault current necessary to operate a fuse/ protective device/ a circuit breaker and shall not exceed 2 Ohm.

3. EARTHING ELECTRODES

3.1 PLATE ELECTRODE

Plate electrodes shall be made of copper/GI plate of 3.15/6 mm thick and 60 x 60 cm size. The plate shall be buried vertically in ground at a depth of not less than 2 meters to the top of the plate, the plate being encased in bitumen and charcoal to a thickness of 15 cm all round. It is preferable to bury the electrode to a depth where subsoil water is present. Earth leads to the electrode shall be laid in a GI pipe and connected to the plate electrode with brass, bolts, nuts and washers. A GI pipe of not less than 25mm dia. shall be placed vertically over the plate and terminated in a funnel at 5 cms above the ground. The funnel shall be provided with a wire mesh. The funnel shall be enclosed in a masonry chamber of 600 cm x 600 cm x 2.5/2.75 cm dimensions. The chamber shall be provided with heavy/Medium duty C.I. cover and C.I. frame. The earth station shall also be provided with a suitable permanent identification using painting.

3.2 PIPE ELECTRODE

Pipe electrode shall comprise of a 2.5/2.75 mtr. long 38/40mm dia class ‘B’ GI pipe buried vertically in a pit of 35cm x 35 cm size and filled with alternate layers of charcoal, salt and connected at the top to a Class ‘B’ GI

pipe of 25mm, 1 meter long with a funnel at the other end, 5 cms above the ground. The earth lead shall be properly bolted to the pipe electrode with brass bolts, nuts and washers. The funnel and earth lead connections shall be enclosed in a masonry chamber of 450 mm. x 450mm. 30cm dimensions or as Per Client approved. The chamber shall be provided with heavy/medium duty C.I. cover and C.I. frame As per client requirements. Proper permanent identification tag/ label shall be provided for each electrode using painting.

3.3 EARTH MAT

If required the earth mat shall be provided as per the sketch and as detailed in drawing.

3.4 PRECAUTIONS

Earthing system shall be mechanically robust and the joints shall be capable of retaining low resistance, even after passage of fault currents.

Joints shall be welded, bolted or double- riveted. All welded joints are painted with cold Zinc galvanizing paint. All the joints shall be mechanically and electrically, continuous and effective. Joints shall be protected against corrosion.

3.5 TESTING

On the completion of the entire installation, test on earth resistance of electrode shall be conducted.

All meters, instruments and labour required for the tests shall be provided by the contractor. The test results shall be submitted in triplicate to the EIC for approval. Tests shall be conducted in the presence of Engineer-in-charge.

10 LIST OF APPROVED MAKES:-

Sl.No	Description	Manufacturer
1	LT Cables/HT Cable	KEI/Havells//Universal/Ravin Cables/CCI/ Polycab
2	LT Cable End terminations	
	a) Metal Glands	HMI/SMI
	b) PVC Glands	HENSEL
	c) Lugs	Dowells/BRACO
3	HT/LT Cable Joint Kit	Raychem
4	DISTRIBUTION BOARDS - PPI (per phase isolation) Type - ETPN/VTPN/SPN	MDS- Legrand /Schneider/L&T Hager
5	MCCB & MCB	MDS- Legrand /Schneider/L&T Hager
6	ELCB/RCCB/RCBO & Surge Protection Devices	MDS- Legrand /Schneider/L&T Hager
7	Industrial Plug & Socket	MDS-Legrand/Schnieder/L&T Hager/Hensal
8	PVC Rigid Conduits-FRLS grade	ATUL/Precision/Nelco/Universal/AKG/Avon plast
9	PVC - flexible conduits.	Finolex/Precision
10	PVC Truff	Precision/Salzer
11	MS Conduit	AKG/Bharat
11.1	Switch and Socket	Crabtree- Verona/Salzer/Legrand Myris
12	Single core multistrand flexible copper wiring cables up to 6sqmm size - Insulation grade FRLS/HFFR/ LSZH/ZHFR	RR Kable / Havells / Lapp/Anchor/Cobra/Unflex/Poly cab
13	Metal Cable Tray	Profab/Puspak/As per EIC t Approved
14	Metal Race ways/Wire Ways and DRAW BOX	Profab/Puspak/As per EIC Approved

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17	Lighting fixtures -Decorative	Arrystrom(RR Kable)/Philips/ EIC Approved
18	Lighting fixtures -Standard	Arrystrom(RR Kable)/Philips/ EIC Approved
19	LED Lamps	Arrystrom(RR Kable)/Philips
20	Exhaust fans	Havells/Crompton Greaves
21	Timers	MK- Honey well
22	Ceiling fans	Havells / Crompton/Usha
22.1	Lightining Protection System	Cape/ Axis/ Clent Approved
23	Lighting Management System/ Lighting Control System	Schneider/Philips-Dynalite/Bell Lighting/Lutron
24	Single core multistrand flexible copper outer FRLS Grade PVC Insulated cables	RRKablel/Havells /Lapp/Polycab/KEI/Rajanigandha/Finolex

SECTION: 06

BILL OF QUANTITY

Preamble

1. The Bill of Quantities shall be read in conjunction with the Instructions to Bidders, Conditions of Contract, Technical Specifications and Drawings.

2. The quantities given in the Bill of Quantities are estimated and provisional, and are given to provide a common basis for bidding. The basis of payment will be the actual quantities of work ordered and carried out, as measured by the Contractor and verified by the Engineer In-charge and valued at the rates and prices tendered in the priced Bill of Quantities, where applicable, and otherwise at such rates and prices as the Engineer In-charge may fix within the terms of the Contract.

3. The rates and prices tendered in the priced Bill of Quantities shall, except in so far as it is otherwise provided under the Contract, include all constructional plant, labour, transportation, supervision, materials, erection, maintenance, insurance, profit, taxes and duties, together with all general risks, liabilities and obligations set out or implied in the Contract.

4. The rates and prices shall be quoted entirely in Indian Currency.

5. General directions and descriptions of work and materials are not necessarily repeated or summarized in the Bill of Quantities. References to the relevant sections of the contract documentation shall be made before entering rates or prices against each item in the Bill of Quantities.

6. The method of measurement of completed work for payment shall be in accordance with the specification for Building Works published by CPWD, Government of India.

7. Rates quoted by the contractor shall include sales tax, duties, octroi, toll tax, realties and all other taxes in respect of this contract and the Employer shall not entertain any claim whatsoever in this respect. Tendered rates are inclusive of all taxes levies payable under the respective statutes. However pursuant to the Constitution (Forty Sixth Amendment) Act; 1982 if any further tax or levy is imposed by Statutes, after the date of receipt of tenders and the contractor there upon necessarily and properly pays such taxes/ levie the contractor shall be reimbursed the amount as per the rules on producing proof of payment so made provided such payments, if any, is not in the opinion of the Employer (whose decision shall be final and binding) attributable to delay in execution of work within the control of the contractor.

Bill of Quantity is linked as

Annexure A

SECTION: 07

DRAWINGS

Representative Drawings are linked as

Annexure B