



**EPC TENDER**

**FOR**

**DESIGN, CONSTRUCTION, TESTING, COMMISSIONING  
AND VALIDATION OF BSL-3 LABORATORY, BSL-2  
LABORATORY & ANIMAL FACILITY (EPC MODE)  
INCLUDING OPERATION & MAINTENANCE**

**AT**

**INSTITUTE OF ADVANCED VIROLOGY, THONNAKKAL,  
THIRUVANANTHAPURAM**

**Tender No. HITES/IDS/IAV-BSL/23/28  
[e-tender ID: 2024\_HITE\_189396\_1]**

**VOLUME- 4**

**DESIGN BASIS REPORT (DBR)**

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## A. PROJECT BRIEF

### 1. INTRODUCTION

Institute of Advance Virology (IAV), Thiruvananthapuram, Kerala has proposed construction of new BSL-3 Laboratory Building, which will have BSL-3 Laboratories, BSL-2 Laboratories, Animal Research Facility along with other the required support facilities and infrastructure.

The EPC contractor shall execute the works on EPC mode including soil testing, statutory approvals and clearances, detailed designs including Architectural designs, Structural Designs, MEP system and Services designs on the basis of conceptual architectural layout plans and other technical details provided in the tender documents. Considerations shall be given for adopting the latest technology available in the field. The EPC contractor shall obtain the required statutory approvals. The execution will be done on the basis of design, planning, drawings and details of work prepared by the EPC contractor and approved by HITES. The complete works shall be designed and executed as per CPWD specifications, relevant IS Codes, National Building Code-2016, DBT Guidelines (Guidelines for the establishment of containment facilities: BSL-2 & BSL-3 and certification of BSL-3 Facility - issued vide No. PID-15011(11)/5/2020-PPB-DBT dated 18.12.2020), ICMR guidelines for establishment of BSL-3 laboratory, Laboratory Biosafety Manual of WHO (4<sup>th</sup> edition), BMBL issued by CDC/NIH (6<sup>th</sup> edition) guidelines, CPCSEA Guidelines for laboratory animal facility & other specifications as applicable, except otherwise mentioned in the bidding documents.

The proposed BSL-3 Laboratory Building is planned as a 2 storeyed building, with functional and support areas as under:

Proposed Floor	Proposed Functional Areas
Ground Floor	Entrance Lobby, Animal Facility, Offices, Effluent Decontamination Plant room for BSL-3 Lab, circulation corridors, AHU & Electrical room, material receipt area, toilet etc. (Refer Ground Floor Layout Plan given in tender)
First Floor	BSL-3 Laboratories, BSL-2 Laboratories, AHU & Electrical room, office space etc. (Refer First Floor Layout Plan given in tender)
Connecting Ramp	It is proposed that the new BSL-3 Laboratory building is connected with two adjoining buildings through a connecting corridor, at first floor level (Approximate 20 mtr of connecting corridor is steel structure with the slab and roof made with decking sheet and concrete. The remaining 60 m is attached to the main structure and is made of RCC. The façade is cladded with structural glazing and ACP. Floor finish of vitrified tile is provided for both the steel and RCC portions of the connecting bridge.)
Retaining wall	RCC Retaining wall along the south side of the building. (Approximate 90mtr length and an average height of 2 to 4mtr)

ESTIMATED CONSTRUCTION AREA ( inSqMtr) IS AS UNDER:

Ground Floor	860.00
First Floor	815.00
Terrace Floor	23.00
Total built-up area	1,698.00
Connecting corridor (RCC)	138.00
Total estimated built-up area incl. Connecting corridor	1,836.00
Connecting corridor (Steel)	40.26

## SCOPE OF WORK OF EPC CONTRACTOR

Being a Engineering, Procurement and Construction Project, the EPC Contractor has to do the detailed design, prepare GFC drawing, get EIC's approval and construct after due vetting of GFC structural drawings by IIT/NIT or any approved Institute of National importance as approved by HITES. The components of work carried out by the EPC Contractor includes, but not limited to the area as follows:

- a. Site Analysis, Topographic survey, Soil Investigation, detailed architectural drawing, structural design, MEP drawings, Vetting of structural drawings, all necessary Local Authorities/Stakeholders/ permissions/ approvals, fulfilment of all the required Contractual Documents to HITES etc.
- b. Detailed design, GFC preparation and obtaining approvals from EIC and complete execution of the following elements, but not limited to, in accordance with the tender documents,
  - i. The complete building works
  - ii. Connecting Corridor.
  - iii. Associated structures
  - iv. Associated utilities and corresponding structures
  - v. Underground utility, diversion if any (Bidders to visit site and confirm any such elements before bidding)
  - vi. Electrical (internal & External)
  - vii. HVAC, fire Fighting works
  - viii. All required ELV systems
  - ix. Sewerage (Internal & External)
  - x. Storm water collection, Under ground sump & Rain water harvesting
  - xi. Signage's
  - xii. Retaining Wall etc.

- c. All Required services designs, Load calculations to be prepared by EPC Contractor and it is to be submitted to HITES as well as Concerned department for their review, comments/approval.
- d. The structural designs of the buildings and all other associated structures shall be done by the EPC Contractor and shall be Proof checked/vetted by the IIT/NIT/or any Govt. Engineering College as approved by HITES EIC.
- e. Obtaining mandatory approvals from local bodies/ statutory authorities, as required for commencement of construction of work.
- f. Obtaining all required statutory approvals during different stages/ phases, before starting, during and after completion of the project.
- g. Supervision of works with required quality assurance.
- h. Any other services and utilities as per requirements and direction of Engineer-In- Charge for completion of the project.

CLIENT/ HITES may, at the written request of the Contractor, assist him in obtaining the approvals from relevant authorities. However any such request by the Contractor shall not bind the CLIENT/ HITES in any manner. The original documents of approval shall be submitted to HITES/Client.

## **B. ARCHITECTURE**

### **1. Room Wise Finishing Schedule GROUND FLOOR**

ROOM NAME / DESCRIPTION	WALL	CEILING/ FALSE CEILING	FLOOR	DOOR
Lobby	Plastered Brick wall, acrylic emulsion paint	Gypsum+Calcium Silicate	Vitrified Tiles	Glass Door
Office	Plastered Brick wall, acrylic emulsion paint	Gypsum+Calcium Silicate	Vitrified Tiles	Laminated Flush Door
Staff Room	Plastered Brick wall, acrylic emulsion paint	Gypsum+Calcium Silicate	Vitrified Tiles	Laminated Flush Door
Rest Room Male	Plastered Brick wall, Dado in vitrified tile	Metal False Ceiling	Anti-skid Vitrified Tiles	Laminated Flush Door
Rest Room Female	Plastered Brick wall, Dado in vitrified tile	Metal False Ceiling	Anti-skid Vitrified Tiles	Laminated Flush Door

DA Toilet	Plastered Brick wall, Dado in vitrified tile	Metal False Ceiling	Anti-skid Vitrified Tiles	Laminated Flush Door
1.5M Wide Corridor	Plastered Brick wall, acrylic emulsion paint	Gypsum+Calcium Silicate	Vitrified Tiles	
Receiving Area	Plastered Brick wall, acrylic emulsion paint	Gypsum+Calcium Silicate	Vitrified Tiles	Glass Door
2.35M Wide passage	Plastered Brick wall, epoxy paint	Epoxy paint	Vitrified Tiles	Powder Coated
AHU Room	Plastered Brick wall, acrylic emulsion paint		IPS Flooring	Powder Coated
CHR 1	Plastered Brick wall, epoxy paint	Epoxy paint	Self Levelling Epoxy	Powder Coated
Shower	Prefabricated Modular in SS	Prefabricated Modular in SS	Prefabricated Modular in SS	Bio Safety Door in SS
CHR 2	Plastered Brick wall, epoxy paint	Epoxy paint	Self Levelling Epoxy	Powder Coated
BSL – 3 BLED Room	Plastered Brick wall, epoxy paint	Epoxy paint	Self Levelling Epoxy	Powder Coated
Incoming Store	Plastered Brick wall, epoxy paint	Epoxy paint	Self Levelling Epoxy	Powder Coated
Cage Wash	Plastered Brick wall, epoxy paint	Epoxy paint	Self Levelling Epoxy	Powder Coated
1.8M Wide Corridor	PCGI Panel (50mm)	PCGI Panel (50mm)	Self Levelling Epoxy	Powder Coated
2.2M Wide Dirty Corridor	PCGI Panel (50mm)	PCGI Panel (50mm)	Self Levelling Epoxy	Powder Coated
Quarantine Room	PCGI Panel (50mm)	PCGI Panel (50mm)	Self Levelling Epoxy	Powder Coated
Air Lock	PCGI Panel (50mm)	PCGI Panel (50mm)	Self Levelling Epoxy	Powder Coated
Exit	PCGI Panel (50mm)	PCGI Panel (50mm)	Self Levelling Epoxy	Powder Coated
DE gowning	PCGI Panel (50mm)	PCGI Panel (50mm)	Self Levelling Epoxy	Powder Coated
Gowning	PCGI Panel (50mm)	PCGI Panel (50mm)	Self Levelling Epoxy	Powder Coated
Entry	PCGI Panel (50mm)	PCGI Panel (50mm)	Self Levelling Epoxy	Powder Coated
Procedure Room 1	PCGI Panel (50mm)	PCGI Panel (50mm)	Self Levelling Epoxy	Powder Coated

Procedure Room 2	PCGI Panel (50mm)	PCGI Panel (50mm)	Self Epoxy	Levelling	Powder Coated
Procedure Room 3	PCGI Panel (50mm)	PCGI Panel (50mm)	Self Epoxy	Levelling	Powder Coated
Imaging Room	PCGI Panel (50mm)	PCGI Panel (50mm)	Self Epoxy	Levelling	Powder Coated
Clean Store	PCGI Panel (50mm)	PCGI Panel (50mm)	Self Epoxy	Levelling	Powder Coated
Autoclave Loading Bay	PCGI Panel (50mm)	PCGI Panel (50mm)	Self Epoxy	Levelling	Powder Coated
Breeding Room 1	PCGI Panel (50mm)	PCGI Panel (50mm)	Self Epoxy	Levelling	Powder Coated
Breeding Room 2	PCGI Panel (50mm)	PCGI Panel (50mm)	Self Epoxy	Levelling	Powder Coated
Breeding Room 3	PCGI Panel (50mm)	PCGI Panel (50mm)	Self Epoxy	Levelling	Powder Coated
Experiment Room 1	PCGI Panel (50mm)	PCGI Panel (50mm)	Self Epoxy	Levelling	Powder Coated
Experiment Room 2	PCGI Panel (50mm)	PCGI Panel (50mm)	Self Epoxy	Levelling	Powder Coated
Experiment Room 3	PCGI Panel (50mm)	PCGI Panel (50mm)	Self Epoxy	Levelling	Powder Coated
Experiment Room 4	PCGI Panel (50mm)	PCGI Panel (50mm)	Self Epoxy	Levelling	Powder Coated
Experiment Room 5	PCGI Panel (50mm)	PCGI Panel (50mm)	Self Epoxy	Levelling	Powder Coated
1.8M Wide Clean Corridor	PCGI Panel (50mm)	PCGI Panel (50mm)	Self Epoxy	Levelling	Powder Coated
Air Lock	PCGI Panel (50mm)	PCGI Panel (50mm)	Self Epoxy	Levelling	Powder Coated
1.5M Wide Dirty Corridor	PCGI Panel (50mm)	PCGI Panel (50mm)	Self Epoxy	Levelling	Powder Coated
Storage	Plastered wall, Brick acrylic emulsion paint		IPS		Powder Coated
MGPS Room	Plastered wall, Brick acrylic emulsion paint		IPS		Powder Coated
UPS Room	Plastered wall, Brick acrylic emulsion paint		IPS		Powder Coated
Electrical Room	Plastered wall, Brick acrylic emulsion paint		IPS		Powder Coated

## 2. Room Wise Finishing Schedule First Floor

ROOM NAME / DESCRIPTION	WALL	CEILING/ FALSE CEILING	FLOOR	DOOR
2.6M Wide Corridor	Plastered Brick wall, acrylic emulsion paint	Gypsum+Calcium Silicate	Vitrified Tiles	Glass Door
1.8M Wide Corridor (Near store & autoclaving)	Plastered Brick wall, acrylic emulsion paint	Gypsum+Calcium Silicate	Vitrified Tiles	Glass Door
BSL-3 AHU Utility Room	Plastered Brick wall, acrylic emulsion paint		IPS Flooring	Powder Coated
BMS Room	Plastered Brick wall, acrylic emulsion paint	Gypsum+Calcium Silicate	Vitrified Tiles	Powder Coated
Store	Plastered Brick wall, acrylic emulsion paint	Gypsum+Calcium Silicate	Vitrified Tiles	Powder Coated
Autoclaving	Plastered Brick wall, epoxy paint	Metal False Ceiling	Vitrified Tiles	Powder Coated
LAB In charge Room	Plastered Brick wall, epoxy paint	Gypsum+Calcium Silicate	Vitrified Tiles	Powder Coated
Air Lock BSL-2	PCGI Panel (50mm)	PCGI Panel (50mm)	Self Levelling Epoxy	Powder Coated
1.8M Corridor (BSL-2)	PCGI Panel (50mm)	PCGI Panel (50mm)	Self Levelling Epoxy	Powder Coated
BSL – 2 Lab 1	PCGI Panel (50mm)	PCGI Panel (50mm)	Self Levelling Epoxy	Powder Coated
BSL - 2 LAB 2	PCGI Panel (50mm)	PCGI Panel (50mm)	Self Levelling Epoxy	Powder Coated
BSL – 2 Lab 3	PCGI Panel (50mm)	PCGI Panel (50mm)	Self Levelling Epoxy	Powder Coated
Serology Lab	PCGI Panel (50mm)	PCGI Panel (50mm)	Self Levelling Epoxy	Powder Coated
Serology Lab A/L	PCGI Panel (50mm)	PCGI Panel (50mm)	Self Levelling Epoxy	Powder Coated
1.875M Wide Corridor	Plastered Brick wall, epoxy paint	PCGI Panel	Vitrified Tiles	Powder Coated
CHR 1	PCGI Panel (80mm)	PCGI Panel (80mm)	Self Levelling Epoxy	Powder Coated
Shower	Prefabricated Modular in SS	Prefabricated Modular in SS	Prefabricated Modular in SS	Bio Safety Door in SS
CHR 2	PCGI Panel (80mm)	PCGI Panel (80mm)	Self Levelling Epoxy	Powder Coated



BSL-3 Virus Lab 1	PCGI (80mm)	Panel	PCGI (80mm)	Panel	Self Levelling Epoxy	Powder Coated
Material Transfer	PCGI (80mm)	Panel	PCGI (80mm)	Panel	Self Levelling Epoxy	Powder Coated
BSL-3 Virus Lab 2	PCGI (80mm)	Panel	PCGI (80mm)	Panel	Self Levelling Epoxy	Powder Coated
Air Lock	PCGI (80mm)	Panel	PCGI (80mm)	Panel	Self Levelling Epoxy	Bio Safety Door in SS
Loading Room	PCGI (80mm)	Panel	PCGI (80mm)	Panel	Self Levelling Epoxy	Powder Coated
Unloading Room	PCGI (80mm)	Panel	PCGI (80mm)	Panel	Self Levelling Epoxy	Powder Coated
1.8M Wide Corridor (BSL – 3)	PCGI (80mm)	Panel	PCGI (80mm)	Panel	Self Levelling Epoxy	Powder Coated
CHR 1	PCGI (80mm)	Panel	PCGI (80mm)	Panel	Self Levelling Epoxy	Powder Coated
Shower	Prefabricated Modular in SS		Prefabricated Modular in SS		Prefabricated Modular in SS	Bio Safety Door in SS
CHR 2	PCGI (80mm)	Panel	PCGI (80mm)	Panel	Self Levelling Epoxy	Powder Coated
Animal Hold	PCGI (80mm)	Panel	PCGI (80mm)	Panel	Self Levelling Epoxy	Powder Coated
Material Transfer	PCGI (80mm)	Panel	PCGI (80mm)	Panel	Self Levelling Epoxy	Powder Coated
Procedure Lab	PCGI (80mm)	Panel	PCGI (80mm)	Panel	Self Levelling Epoxy	Powder Coated
Air lock	PCGI (80mm)	Panel	PCGI (80mm)	Panel	Self Levelling Epoxy	Bio Safety Door in SS
Loading Room	PCGI (80mm)	Panel	PCGI (80mm)	Panel	Self Levelling Epoxy	Powder Coated
Unloading Room	PCGI (80mm)	Panel	PCGI (80mm)	Panel	Self Levelling Epoxy	Powder Coated
1.8M Wide Corridor (BSL – 3)	PCGI (80mm)	Panel	PCGI (80mm)	Panel	Self Levelling Epoxy	Powder Coated
1.8M Wide Outer Corridor	Plastered wall, epoxy paint	Brick	PCGI (50mm)	Panel	Vitrified Tiles	Powder Coated
Staff Room	Plastered wall, emulsion paint	Brick acrylic	Gypsum + Calcium Silicate		Vitrified Tiles	Powder Coated
Rest Room Male	Plastered wall, dado in vitrified tile	Brick	Metal False Ceiling		Anti-skid Vitrified Tiles	Laminated Flush Door

Rest Room Female	Plastered Brick wall, Dado in vitrified tile	Metal False Ceiling	Anti-skid Vitrified Tiles	Laminated Flush Door
Storage / Service	Plastered Brick wall, acrylic emulsion paint	Gypsum + Calcium Silicate	Vitrified Tiles	Powder Coated

### 3. External Finish & Fittings/Accessories

1	External finishing	Exterior grade emulsion paint - textured and non-textured; concrete cladding tiles as per design; ACP; structural glazing, granite cladding, curtain glazing, aluminium louvers, perforated aluminium vertical fins, GRC Jali, ACP
2	Toilet fittings and accessories (all accessories in stainless steel - as per approved sample)	Sink, sink cocks, sink mixers, wash-down type water closets, health faucet, wash basin, drain, mirror, towel rod, towel ring etc.
3	Washbasin mirror in toilets	6mm thk clear looking mirror with 12mm thk BWP ply paint finish fixed SS flat button studs
Note:		Wall and ceiling corners of modular wall and ceiling panels shall be provided with R75 radius aluminium coving in same shade as of wall panels. Wall to floor corners shall be provided with epoxy coving in same or approved colour rop coat and in same radius as of aluminium coving provided for wall to wall and wall to ceiling coving
		Dado tile size should be 300x600mm
		Grill to be provided for all the external windows

## C. STRUCTURE WORK

### GENERAL:

The Proposed scope of work includes Site visit, analysis to carry out the proposed Construction of BSL-3 Laboratory, BSL-2 Laboratory & Animal Facility Building at Institute of Advance Virology Bio 360 Life Science Park Thonnakal, Trivandrum on EPC basis. The detailed structural design of buildings shall be done by the EPC Contractor and Proof checked/vetted by IIT/NIT or any approved Institute of National importance. The requirements for the structural designs are briefed here under.

### GEO TECHNICAL INVESTIGATIONS:

The EPC Contractor shall, after award of work, carry out the required site surveys and soil investigations and obtain soil investigation report as per IS Code requirements, through the specialized agencies, with the prior approval from HITES. The purpose of the investigations is to determine the sub soil stratification, geotechnical information & safe bearing capacity, so as to provide information that will assist the structural engineers in the design of the foundations and the relevant works for the construction of BSL-3 Laboratory, BSL-2 Laboratory & Animal Facility Building at Institute of Advance Virology Bio 360

Life Science Park Thonnakal, Trivandrum. The job is to be carried out by Registered/certified (NABL & ISO etc.), Soil Testing Laboratory agency under the guidance and supervision of Geotechnical personnel/Consultant. The soil investigation includes drilling boreholes by using rotary drilling, conducting Standard Penetration Test (SPT) and collecting sample for classification and identifications. Bore holes shall be taken as per IS Code requirements and instruction by design consultant. The report need to be checked and signed off by a professional with a minimum of Post Graduate qualification in Geotechnical Engineering field and has an experience of minimum 15 years in a similar field. EPC Contractor may get the required site surveys and soil investigations conducted for his assessment, prior to bidding, as per his requirements if needed. An indicative soil investigation report done in the locality is enclosed as ANNEXURE – 1.

As per standard norms, soil investigation is to be carried out to get proper test report, if any.

### **STRUCTURE DESIGN - INTRODUCTION:**

The objective of this report is to lay down the design basis report for the structural design of the construction of BSL-3 Laboratory, BSL-2 Laboratory & Animal Facility Building at Institute of Advance Virology Bio 360 Life Science Park Thonnakal, Trivandrum. This report covers the design requirements which will form the overall design philosophy to be adopted in the structural design of the project.

The objectives of these reports are stated as follows:

- Define the engineering strategy and parameters in relation to the building structure and architectural concept.
- Identify and record all input requirements as well as analysis and design criteria.
- Develop structural scheme compatible with architectural vision, MEP requirements and client's needs.
- Prepare structural design that will aim to achieve structural stability, durability and integrity.
- Desirable structural performance under characteristic load during service life of structure.

The structural design of buildings shall be done by the EPC Contractor and verified by HITES design team before submitting for Proof checking/vetting by IIT/NIT or any approved Institute of National importance. The requirements for the structural designs are briefed hereunder.

### **STRUCTURAL SYSTEM – CONCEPT OF DESIGN:**

Structural system adopted for Buildings is RCC Rigid Frame with beams, columns/shear wall as per the design requirements.

The foundation system shall be proposed and designed as Isolated Footings / Combined Footings / Raft / piled raft / pile foundations, with respect to the structural design requirement in conjunction with the recommendations provided by the Soil Investigation Report.

The structural loads shall be considered with respect to the approved final Architectural drawings.

### **LATERAL SYSTEM:**

Lateral system consists of special moment resisting frames. For the purpose of stability of the structure, as a whole, against overturning, the restoring moment shall not be less than 1.2 times the maximum overturning moments due to dead load and 1.4 times the maximum overturning moments due to imposed loads. In case where dead load provides the restoring moments, only 90% of dead load shall be considered and the restoring moments due to imposed loads shall be ignored.

The Proposed Factor of Safety against sliding shall not be less than 1.40.

Factor of Safety against buoyancy shall be not less than 1.20 considering only the self-weight of structure. For the design of R.C.C. elements, the Limit State Method will be used as per IS 456-2000. For the design of Steel members, to be used as per IS800-2007.

Material of construction will be predominantly R.C.C structure with consideration for ductility. Cover to reinforcement shall be in accordance with IS: 456:2000 corresponding to the exposure conditions for the super-structure, sub-structure and to satisfy a fire rating of 2 hrs as per the latest code.

### **COMPUTATION MODELING:**

The buildings are to be designed as 3-D frame structure for different load combinations as a composite structure or with steel design for the connecting corridor as a separate structure with respect to relevant IS standards. The analysis & design of idealized model is to be carried using “ETABS/STAAD PRO” latest version of computer program providing design and detailing as per latest IS codes.

The analysis of the proposed structure would be carried to:

- Ensure elastic behaviour and fulfilment of serviceability criteria for un-factored load combination.
- Ensure adequate structural integrity for factored load combinations.
- Obtain static and dynamic displacements and rotations at various nodes.
- Obtain resultant member forces like bending moments, shear forces and axial forces.
- Obtain support reactions (axial force and moment) coming on foundations.

### **CODE REQUIREMENTS:**

The relevant Indian Standard Codes with latest amendments and latest version, as given below shall be followed for structural design.

<b>Sl. No</b>	<b>CODE</b>	<b>DESCRIPTION</b>
1	IS-875 (Part 1) – 1987	Code of Practice for Design Loads (other than earthquake) for buildings and structures – Unit weights of buildings materials and stored material

2	IS-875 (Part 2) – 1987	Code of Practice for Design Loads (other than earthquake) for buildings and structures – Imposed loads
3	IS-875 (Part 3) – 2015	Code of Practice for Design Loads (other than earthquake) for buildings and structures – Wind loads
5	IS-875 (Part 5) – 1987	Code of Practice for Design Loads (other than earthquake) for buildings and structures – Special loads and load combinations
6	IS: 456 – 2000	Code of Practice for Plain and Reinforced Concrete
7	IS: 1786 – 2008	Specification for High Strength Deformed Bars and Wires for Concrete Reinforcement
8	IS: 432 (Part 2)- 1982	Specification for Mild Steel and Medium Tensile Steel Bars and Hard Drawn Steel Wire for Concrete Reinforcement – Hard Drawn Steel Wire
9	IS: 13920 -2016	Ductile detailing of reinforced concrete structures subjected to seismic forces - Code of practice
10	IS: 2062 –2011	Hot rolled medium and high tensile structural steel — Specification
11	IS: 1161 –2014	Steel Tubes For Structural Purposes — Specification
12	IS: 800 – 2007	Code of Practice for General Construction in Steel
13	IS:1893-2016	Criteria for Earthquake resistant design of structures
14	IS : 269 –2015	Ordinary Portland Cement - Specification
15	IS : 1489 -2015	Specification for Portland pozzolana cement
16	IS : 383 -2016	Specification for coarse and fine aggregates
17	IS:432-1982	Specification for Mild Steel and Medium Tensile Steel Bars and Hard Drawn Steel Wire for Concrete Reinforcement
18	IS:4990-2011	Specification for plywood for concrete shuttering works
19	IS : 2645 -2003	Specification for integral cement water proofing compounds
20	IS: 2950 (Part 1) - 1981	Code of Practice for Design & Construction of Raft Foundations
21	IS 2911 : 2010	Design And Construction Of Pile Foundations
22	IS 2911 (Part 4) 2013	Design and construction of pile foundations - Code of practice : Part 4 Load test on piles.
23	NBC-2016	National Building Code of India
24	IS:3370 (Part 1 to 4) - 2021	Code of Practice for Concrete Structures for Storage of Liquids.

25	IS 1904:2021	General Requirements for Design and Construction of Foundations in Soils — Code of Practice
26	IS 4326-2013	Code of Practice for Earthquake Resistance Design and Construction of Buildings

Note: The above list of codes is suggestive and not exhaustive. Apart from these basic codes, any other relevant codes shall also be followed wherever required.

### **DESIGN LIFE OF STRUCTURES:**

The design life of the building to be considered as per IS code recommendation, satisfying the criteria of environmental conditions. This requirement is applicable separately for concrete works and replaceable finishing materials, waterproofing membrane and thermal insulations (if any).

### **DESIGN METHODOLOGY:**

The structural analysis and design of the building is to be performed as per the governing guidelines of the relevant Indian Standard Codes. Applicable Dead, Live, Wind and Seismic Loads along with appropriate load combinations are to be considered. Software like STAAD, ETABS, RCDC and SAFE shall be used for analysis and design. The structural design of the foundation shall be on the basis of the safe bearing capacity of soil at the foundation levels provided in the approved geotechnical investigation report.

The design of all structural RC elements should be based on the Limit State method of design as specified in IS 456-2000. The design of all structural steel elements like columns, beams and deck should be based on the Limit State method of design as specified in IS 800-2007.

### **PROPERTIES OF MATERIAL:**

#### **CONCRETE:**

The following minimum grades of concrete shall be used for the construction of the structure. All concrete mix shall be as per IS 456-2000.

##### **Minimum Grade of Concrete:**

- Foundations - M25
- Water Tanks - M30
- Columns - M25
- Beam & slab - M25
- Stair waist slab - M25
- UGT - M30

### **REINFORCEMENT:**

High yield strength deformed bars with minimum  $F_y = 500 \text{ N/mm}^2$  or more confirming to IS: 1786 – 2008 shall be used in the project

**STRUCTURAL STEEL:**

The property of structural steel shall be followed as per Indian standards or relevant IS 800-2007 and relevant codes.

**EXPOSURE CONDITION:**

Structural elements are to be designed for moderate exposure.

**COVER TO REINFORCEMENT**

From durability consideration, exposure condition is assumed to be Moderate. The clear cover to main reinforcement shall be considered in the design, satisfying durability & 2 hrs. fire rating requirement, which shall be as follows (Refer: clause No. 26.4.2, Clauses 21.4, 26.4.3 and Fig 1 of IS 456-2000 or clause 21.2 of IS:456-2000 or NBC 2016 whichever is higher).

A	Footing	50MM
B	Columns	40 MM
C	Floor/Roof Beams	30 MM
D	Floor /Roof Slab	25 MM
E	Staircase Waist Slab & Landing	25MM
F	Water retaining tank walls	50MM

**FIRE RESISTANCE:**

The structure is designed for 2 hr fire rating, as the firefighting system and fire hydrants are available within the building. The minimum clear cover to reinforcement and minimum dimensions of RC structural members as per clause 21.2 of IS:456-2000 shall be as follows considering 2 Hr fire rating.

Sl. No.	Structural member	Minimum dimension	Minimum clear cover
1	Column fully exposure to fire	300 mm	40 mm
2	Beams (continuous)	200 mm	30mm
3	Beams (Simply supported)	200 mm	40mm
4	Floors (continuous)	125 mm	25 mm
5	Floors (Simply supported)	125 mm	35 mm

### **LOADS:**

The structural members are loaded with various loads combinations during its services conditions. The loads on the structure are taken for analysis and design as per the relevant IS codes of practice.

- Dead load as per IS: 875 -1987 Part-1
- Imposed live load as per IS: 875 -1987 Part-2
- Wind loads as per IS: 875– 2015 Part 3
- Seismic Loads as per IS: 1893-2016

### **STOREY DRIFT:**

The story drift in any story due to the minimum specified design lateral force, with load safety factor of 1.0 is restricted to 0.004 times story height as specified in IS 1893 – 2016.

### **CRACK WIDTH:**

In view of geographic location of the project, it can be classified under moderate atmospheric condition. Based on this assumption and as per IS 456: 2000, crack width in RCC elements shall be restricted to 0.2 mm. For water retaining structures crack width shall be limited as per IS 3370 latest.

### **LATERAL DISPLACEMENT LIMIT:**

The lateral displacement limit to the minimum specified design lateral force, with partial load safety factor of 1.0 is restricted to H/500 (approx.) in order to ensure minimum damage to Non-structural elements (NSE) and structural elements (SE).

### **TEMPERATURE ANALYSIS:**

The structure will be subjected to:

1. Thermal variation during construction of building
2. Thermal variation during operational life span of structure

When RCC work is completed, building will experience temperature variation during peak atmospheric conditions. In view of maximum and minimum peak temperature data available, temperature load shall be considered. Load combinations for temperature loads are followed from IS 875 Part V – 1987.

**MAX. ALLOWABLE DEFLECTION** – (Including the effect of temperature, creep and shrinkage)

1.Concrete	As per IS 456 2000 clause 23.2	(for gravity load) Floors
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2.Steel / composite	As per table 6 IS 800 – 2007	(for gravity load) Floors
Lateral (1 & 2)	H/500	(for lateral load)

### **LOAD COMBINATIONS:**

All structural designs are carried out by the Limit State method of design. For this purpose the Load factor for various load combinations indicated in IS: 456-2000, IS: 1893-2016 and IS 1904.2021, latest editions are to be followed.

### **DESIGN PHILOSOPHY**

To meet the design life and durability requirements, code provisions specified in clause 8.0 and table 5 of IS: 456- 2000 will be followed for reinforced Concrete Elements. All structural elements would be designed according to the Limit State Method as specified in IS: 456: 2000.

#### **a. Underground Sump /Overhead Water tank**

Underground water tank would be designed to sustain the following two cases

- Tank full and No earth fill.
- Tank empty and active earth pressure acting from outside.

The walls and base slab would be designed as per the provisions of IS: 3370 (Part1 to Part4)-latest edition.

Overhead water tank would be designed to sustain the water load at full tank condition as per the provisions of IS: 3370 (Part 1- Part4) –latest edition.

#### **b. Expansion & Construction Joints:**

Expansion joints are recommended when the length of the structure exceeds 45m . The width of the seismic joints are to be calculated as per IS-1893-2016, clause 7.11. Incase Seismic joints are not provided , thermal analysis shall be carried out to ascertain their effect and accordingly the design shall be carried out.

Construction joints will be planned with the coordination of construction agencies.

#### **c. Foundation**

Foundation final conclusion to be made/decided, after conducting required soil investigation test at Proposed construction sites as well as joint discussions done by Soil and Structural Consultant along with Principal Consultant and Client.

#### **d. Detailing**

The reinforcement layout should take into account the strength requirements as well as the economy of construction. Following are the requirements of good detailing.

- Reinforcement steel of same type and grade shall be used as main reinforcement in a structural member. Provisions of IS: 456-2000, IS 13920-2016 and IS: SP 34 shall be followed for the purpose of detailing of reinforcement.
- Cracking of concrete should be within the permissible limits.
- There should not be any free paths for propagation of cracks without being traversed by reinforcement.
- Joints and discontinuities should be capable of withstanding the same forces as the adjoining sections.
- Reinforcement should not deviate from the direction of tensile stresses.

e. **Proof checking**

All structural drawings are to be prepared based on the detailed soil investigation and vetted by the IIT/NIT or any institute of national importance and approved by EIC.

## **D. PLUMBING**

### **1. INTRODUCTION**

The EPC Contractor shall carry out Design, Engineering, Supply, Installation, Testing & Commissioning for Plumbing (Water Supply and Sanitary Installation System). The work shall in general conform to the Latest CPWD Specifications and tender specifications, as specified and applicable. The water supply and sewerage demand shall be estimated, based on the population as required by NBC norms, Local bye Laws & statutory norms, etc, as applicable.

**CODES AND STANDARDS:**

NBC / CPWD	National Building Code 2016/ CPWD Specifications
IS 10446 – 1983	Glossary of terms relating to water supply and sanitation
2017 Edition	Uniform plumbing code of India
IS 1701 – 1960	Specification for mixing valves for ablutionary and domestic purposes
2019 Edition	CPHEEO Manual
IS 3311 – 1979	Specification for waste plug and its accessories for sinks and wash basins.
IS775 – 1970	Specifications for CI brackets and supports for wash basins and sinks.
IS 9763 – 2000	Plastic Bib Taps, pillar taps, angle valves and stop valves for hot and cold water services.
IS 13983 – 1994	Stainless steel sinks for domestic purposes – Specification
SP –35	Handbooks of water supply and drainage (with special emphasis on plumbing)
SP 7 – 1983	National building code of India (Part IX – Plumbing services)
IS 2379 –1963	Specification of color code for the identification of pipes
IS 10446 – 1983	Glossary of terms relating to water supply and sanitation.
IS 310 –1965	Code of Practice for Water Supply
2020 Edition	Guidelines For The Establishment Of Containment Facilities: Biosafety Level 2 (Bsl-2) & 3 (Bsl-3) And Certification Of Bsl-3 Facility
IS 1172-1983	Code of Basic Requirements for water Supply, Drainage and Sanitation (Third Revision)

**2. PLUMBING APPROACH SPECIFIC TO BIO SAFETY LAB 3**

This section highlights a number of important considerations and unique aspects for plumbing systems serving BSL-3 containment areas

- Water supply line for BSL-3 Lab must be isolated from other functional areas and protected with an approved backflow preventer installed outside of the containment area.
- Sinks and Faucets: Hand-wash sinks in BSL3 Labs and Animal Facility should be in stainless construction.
- Faucets within containment space shall have gooseneck-type spouts and be fitted with an integral vacuum breaker and laminar flow, non-aerating, non-splash outlet. The use of separate outlet taps for hot and cold water is not acceptable. Faucets shall be fully hands-free operation.
- Emergency eye wash stations shall be configured as an isolated potable supply, for sensor-based or foot / elbow operated eye wash station should also be there.

- Showers: Showers in BSL-3 laboratory shall be provided with batch controller to enable program and adjust shower cycle and flow rate. Hand-held showers shall not be utilized.
- Drain water from containment area of BSL-3 Lab like shower, hand wash sink, eye wash, dunk tank, autoclave chamber condensate etc. should be connected to the biological effluent decontamination system and should not be disposed off in municipal drain without decontamination treatment.
- Drain line vent shall be protected by HEPA filters, installed in housing with provision for filter decontamination before removal and filter testing.
- Cleanout plugs in BSL-3 drain piping shall be within the containment zone.
- The scope is not limited to this and all the facilities required for the complete functioning of BSL 3 to be implemented.

### **3. APPROACH TO PLANNING**

The Plumbing services for the project are designed keeping in view the following:

- The OH water storage tank capacity shall be planned and provided for at least two days consumption.
- Implementation of requirements of Kerala Building Rule relating to rainwater harvesting, water conservation, etc. Scope shall be to integrate with existing rainwater harvesting system.
- Economic designs with cost effectiveness.
- Appropriate selection/recommendation of materials and equipment in terms of technology, efficiency and cost

### **4. WATER SUPPLY SYSTEM:**

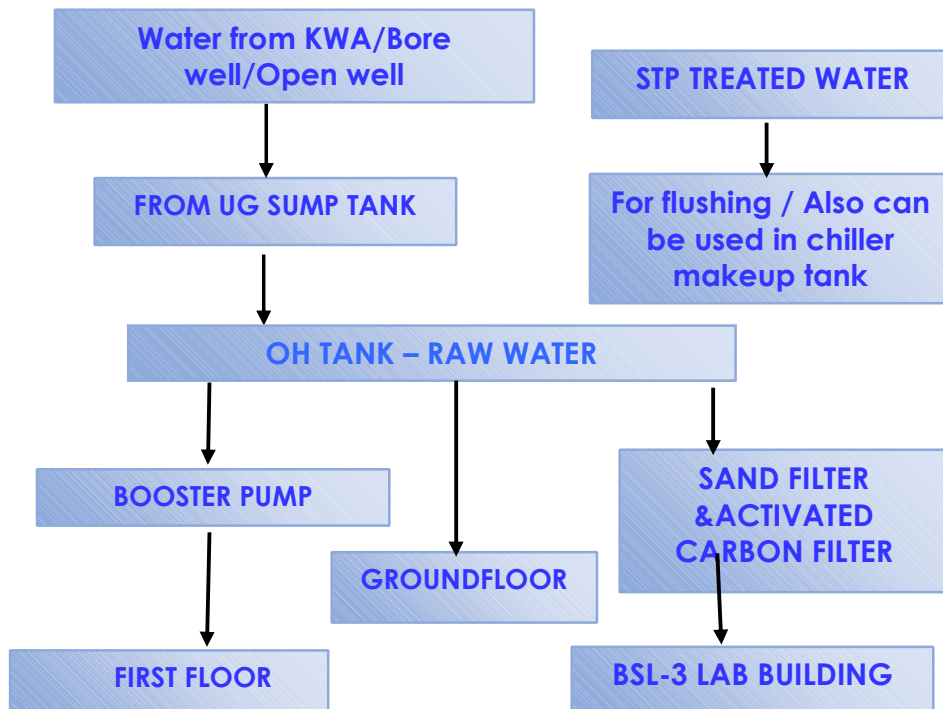
#### Water source

For continuous water supply at adequate pressure, complete water supply system shall be designed with following considerations

- Separate OH water tanks shall be provided for raw water and treated water.
- Main incoming water line shall be tapped from existing nearest available water supply source water source. All required and necessary piping, valves, fittings, pumping arrangements etc. shall be considered in designs and shall be provided.
- The main water supply lines to OH head tank shall be designed via CPVC – Schedule 80 pipes conforming to latest standard. The water supply lines shall be designed with different diameters as per standard installation methodology. All the operational valves/fittings also be designed as per latest IS Code.
- Water supply distribution pipes from terrace to down take in the shaft up to the entry into the floors shall be with CPVC SCH 80 and floor distribution shall be SCH 40. The water supply pipes from the shaft upto the floors shall be of CPVC pipes of required grade/class, conforming to the requirements of IS 15778 Codes.
- To regulate the water supply, valves and fittings, at required places, shall be fixed as per specification. These valves shall be placed outside the containment area so that this can be controlled from outside area and proper care have to be taken while considering the joints fixing etc. so that leakages can be avoided.

- Each water supply line shall be marked for identifications.
- Minimum pressure of 1.0 kg/sq.cm shall be maintained in pipeline system.
- The sizing of the entire distribution network should be based on the simultaneous use of fixture unit's demand as per NBC.
- The raw water and treated water supply pipe-line shall be segregated.
- The toilets and cage wash area shall be supplied with raw water.
- The HVAC system, BSL-3 laboratories, BSL-2 laboratories, Animal facility, Autoclave boiler, Effluent decontamination plant boiler, hand wash and eye wash shall be provided with treated water supply.
- The required treated water quality for HVAC system and boilers shall be as per manufacturers recommendations. Any additional filtration system needed to ensure water quality for any specific equipment use shall be designed accordingly and provided.
- For maintaining water pressure, booster pump shall be considered, if required.

#### **SCHEMATIC DIAGRAM OF WATER SUPPLY SYSTEM:**



#### **CALCULATION OF TOTAL WATER REQUIREMENT**

The actual total water requirement for the BSL-3 Laboratory, BSL-2 Laboratory & Animal Facility building shall be calculated by the EPC contractor and submitted to HITES for approval. Design Consideration shall be as per the NBC-2016 and specific requirement for different equipments and point of use.

#### **PIPE SIZING:**

In compliance with standards the maximum velocity in pipes are limited as follows

- Max Velocity in main lines : 10 Ft / Sec
- Max Velocity in branch lines : 7 Ft / Sec

#### **Pumps**

Adequate pumps, as per requirement, are to be identified and provided for the pumping of water supply from UG Sump to the overhead tank. The Pumps shall be in (1 running and 1 standby) configuration, controlled by automatic level controller.

If required, Pumps shall be provided to carry effluent from animal facility to the existing STP (1 running and one standby) controlled by an automatic level controller.

#### **5. Solar water heating system**

A separate solar heating line shall be also provided for cage washing and Lab as per the requirement. The sink provided for washing shall have hot water line also. Solar water heating systems include storage tanks and solar collectors. There are two types of solar water heating systems active and passive. Solar water heaters require a well-insulated storage tank. Solar storage tanks have an additional outlet and inlet connected to and from the collector. In two-tank systems, the solar water heater preheats water before it enters the conventional water heater. In one-tank systems, the back-up heater is combined with the solar storage in one tank. 2 units of solar water heating system using flat plate collector of capacity 500L/day is used. Flat Plate Collectors (FPC) based Solar Water Heaters use the solar radiation absorbed by Flat Plate Collectors which consist of an insulated outer metallic box covered on the top with glass sheet. Inside there are blackened metallic absorber (selectively coated) sheets with built in channels or riser tubes to carry water. The absorber absorbs the solar radiation and transfers the heat to the flowing water.

The actual capacity need to be calculated by the EPC contractor.

#### **6. Activated Carbon Filter (ACF):**

Water from OH Tank is feed to ACF to remove chlorine, remaining organics and color, smell with the help of carbon media and then to lab.

Activated carbon water treatment is basically used for two water treatment purposes and each work in totally different ways.

1. Chlorine Removal: Activated carbon may be used to remove chlorine with little degradation or damage to the carbon.
2. Removal of Organic Matter: As water passes through an activated carbon filter, organic particles and chemicals are trapped inside through a process known “adsorption”.

The adsorption process depends upon:

- physical properties of the activated carbon (surface area and pore size distribution)
- the chemical makeup of the carbon source (amount of hydrogen and oxygen)
- the chemical makeup and concentration of the contaminant
- water pH and temperature
- Length of time the water is exposed to the activated carbon filter (called empty bed contact time or EBCT).

Carbon beds should be backwashed to help remove trapped silt, prevent packing and head loss, and to remove carbon fines produced by friction between granules. The filter is backwashed when differential pressure goes above 0.5 kg/cm<sup>2</sup> or it stops giving desired output.

The actual design to be done by EPC contractor.

## **7. SEWAGE DISTRIBUTION/PIPING SYSTEM**

### **Scope of Work:**

- Sewage piping network surrounding the building, including Inspection Chambers, Manhole chambers etc.
- The sewage generated from the BSL-3 Laboratory building shall be fed into the central existing sewer lines in the campus.

### **System Philosophy:**

- From Toilets and wash area through network of pipe line to Gully Trap, battery of inspection chambers, Manholes to STP.
- Design of the networking on the basis of the following:
  - Sizing by Manning’s Formula with consideration of half full or 2/3 of full running pipe
  - Suitable self-cleansing velocity (0.75mtr/sec)
  - Minimum scouring velocity( 2.5mtr/sec)

## **8. DRAINAGE SYSTEM**

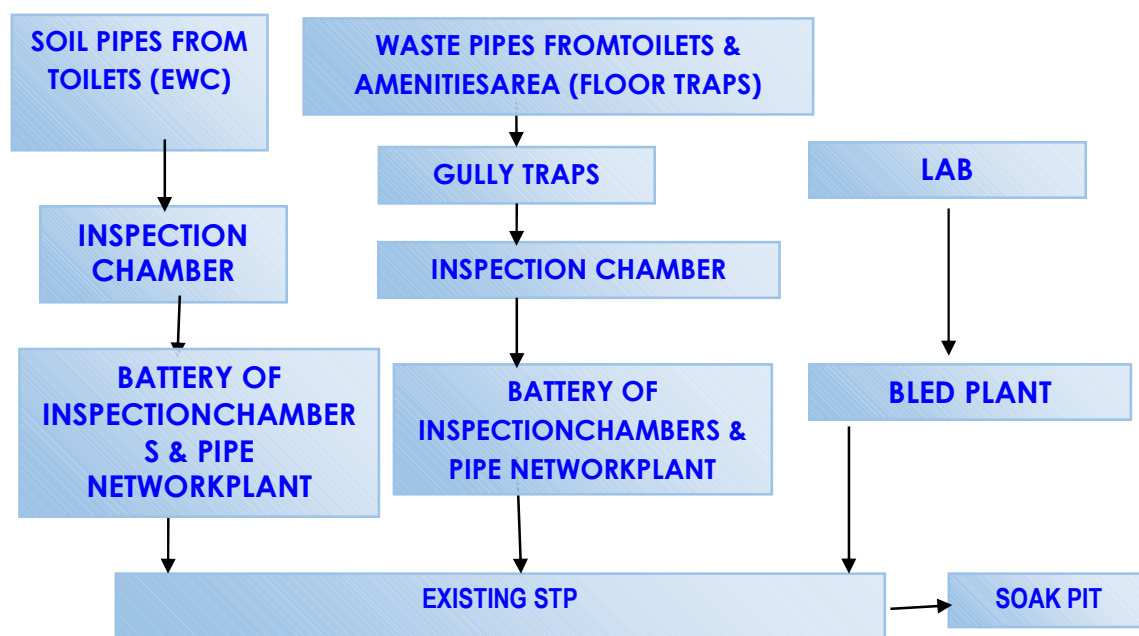
### **I. GENERAL:**

- Drainage system for soil and wastewater will be based on most efficient, functional and economical design, with minimum maintenance after installation and available site conditions, minimum excavation of soil for laying of pipes.
- Within the Building block, drainage piping shall be designed on the basis of two pipe system as recommended in code of practice for soil and wastewater separately from served areas, under gravity.
- Waste and soil vertical pipes running in toilet, utility shall be connected to vertical pipe in shaft and finally dropped down to ground level through the ducts.
- Waste pipes shall be connected to inspection chambers through gully traps by running these pipes suspended horizontally with required slope at ground floor level.
- Soil pipes will be connected directly to inspection chambers. The sewer line shall be connected through a battery of inspection chambers and man holes and then to existing STP.

## **II. DESIGN PARAMETERS**

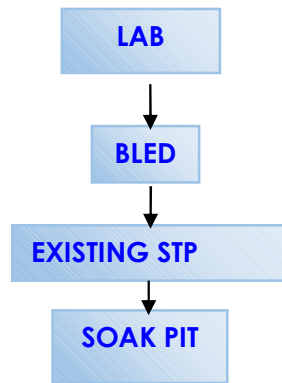
- Piping system has been designed in accordance with Code of Practice for Installation of Soil & Waste Pipes. Provision has been made to provide cleanout doors and plugs for Roding and maintenance where necessary and required.

### **SCHEMATIC DIAGRAM OF DRAINAGE DISPOSAL SYSTEM:**



## **9. BIOLOGICAL EFFLUENT DECONTAMINATION PLANT**





The effluent from BSL-3 Laboratory showers, hand wash sinks, dunk tank drain, autoclave chamber drain and other potentially contaminated drain shall be connected to the Biological Effluent Decontamination Plant. Only decontaminated effluent from BSL-3 laboratory shall be discharged in normal drains. A suitable sump shall be designed and provided inside the BLED plant room where the decontaminated effluent from plant can be released/drained and mixed with cold water to lower the water temperature. Pumping arrangement shall be designed and provided in the sump with 1 working + 1 standby configuration pumps for pumping out the decontaminated and cooled water into external drain lines.

#### 10. Design Criteria for sewage

The system shall be designed as per following design criteria stipulated in the “Manual for Sewerage & Treatment” published by the Central Public Health and Environment Engineering Organization, Govt. of India, IS-SP/35(S&T)-1987 and National and International practices on the subject.

a.	Flow of sewage	80% of water supply (peak flow)
b.	Peak flow	3 times average flow
c.	Min. diameter of pipe	110/150 mm dia
d.	Min. velocity in pipe	0.6 mps
e.	Max. velocity in pipe	3 m / second
f.	Flow conditions in pipes:	
	Pipes up to 400 mm dia.	0.50 full running
	Pipes above 400 mm dia.	0.67 full running
g.	Min. depth of pipe below ground level	
	For branches	0.6 m
	For other	1.0M

## **11. RAINWATER HARVESTING & STORM WATER MANAGEMENT:**

Storm water management shall include planning for runoff, maintaining storm water systems, and regulating the collection, storage, and movement of storm water. The storm drainage systems shall be designed for peak rainfall intensity of 100mm/hr.

Rainwater storage Arrangements.-

Rainwater storage arrangements shall be provided as an integral part of all new building constructions through the collection of rooftop.

The components of a workable ground water recharge arrangements shall include

- (i) Roof gutters;
- (ii) Down pipe and first flush pipe arrangement;
- (iii) Filter unit; and
- (iv) Storage tank with provisions for drawing water and spill-over.

As per KMBR, for industrial occupancy Group, the minimum capacity of rain water storage tank shall be at the rate 50 litres/sq.m of floor area. Hence, the capacity of Rain water harvesting tank to be provided

$$\begin{aligned} &= 50 \text{ litres/sqm of covered area} \\ &= 50 \times 556 \\ &= 27,800 \text{ litres} \\ &= 28,000 \text{ litres} \end{aligned}$$

The storm water (water running at ground lvl) will be collected through a no of catch basins and will be routed to external public drainage systems.

The frictional coefficient of the open drains is considered to be 0.015, 0.85 for roof area, 0.6 for road and paved areas. All pipes will be class LA PVC pipes for vertical drain system and external horizontal runs. Coefficient of permeability factors are also considered for effective ground percolation. The rain water tank is to be provided. The rain water overflow from tank should be connected to soak pit. The excess storm water from the open yards shall be drained out through storm water drain channel constructed along the periphery of the plot to the nearest public drain channel.

## **DESIGN BASIS REPORT - ELECTRICAL & ELV SERVICES**

### **1.GENERAL**

The EPC Contractor shall carry out detailed Planning, Design, Engineering, Supply, Installation, Testing & Commissioning of complete Internal & External Electrification, Extra Low Voltage (ELV) systems as required for smooth functioning

of the proposed BSL-3 Laboratory, BSL-2 Laboratory & Animal Facility Building at Institute of Advance Virology, Thonnakkal, Kerala.

Design guidelines of Electrical & ELV works, Standards and Codes for different equipments, services, systems, installation, testing, commissioning, handing over, power supply requirements, details of services, accessories, systems required for Electrical & ELV services, EPC contractor's scope etc. are mentioned in the following sections

Design of systems, services, equipments, accessories, Quality of material to be used in Electrical, ELV works, Quality of workmanship, Installation, Testing, Commissioning, Safety methods are to be strictly adhered by complying with applicable codes or guidelines mentioned in the relevant systems/services.

The Electrical & ELV works shall also meet all the requirements for the satisfactory operation, monitoring & utilization of other services like Heating Ventilation & Air Conditioning (HVAC) system, Fire fighting system, Lifts, lab equipments, UPS, Water distribution System, Sewerage lifting system, Rainwater pumping system, External lighting, all ELV works for fulfilling the smooth functioning of the facility with trouble-free operation of utilities, avoiding damages to equipments, and ensuring safety for the community and end user.

Note:

The quantities, rating and capacity of equipment indicated anywhere are minimum to be provided. However, during detailed designing, if required and found necessary, the capacity/ rating of the equipment may be upgraded by the EPC Contractor, without additional cost.

## **POWER SUPPLY SOURCE & MODIFICATION WORK IN THE EXISTING ELECTRICAL SYSTEM**

The adjacent building (Phase 1B) has an 11kV substation in the basement floor. An existing 400kVA DG set is catering building 1B which is connected to the Main LT cum AMF panel.

Proposed 400kVA DG set shall be connected to the spare breaker available in the Main LT cum AMF panel of building 1B.

One of the outgoing breakers from the existing Main LT cum AMF panel of building 1B shall be connected to the Main electrical panel of the proposed BSL 3, BSL 2 and Animal House facility by laying LT cables through either RCC trench or hume pipe as per site conditions and directions of HITES/Client.

The size and number of runs of LT cables shall be calculated on assessing connected load of BSL 3, BSL 2 and Animal House facility, voltage drop calculations etc

EPC bidder may assess the volume of work in connection with modifications / additional works by conducting site survey and discussion with HITES/client

1. Replacement of existing energy meter & CT (If applicable) to match with additional load requirement and as per recommendations of KSEI & KSEB
2. Additional cubicle & breakers in the existing LT panel of building 1B to connect the main panel of proposed new BSL 3, BSL 2 and Animal House facility.
3. Providing synchronizing panel in existing Main LT cum AMF panel of building 1B
4. Programming the logic operation of both DG sets connected in the main LT cum AMF panel
5. Additional electrical panel, if required to cater power supply to BSL 3, BSL 2 and Animal House facility.
6. Additional capacitor bank or new capacitor bank on account of increase in power demand by adding BSL 3, BSL 2 and Animal House facility in the existing electrical scheme
7. Cables, cable containment system & allied works in connection with modifications work in substation 1B
8. Approvals from statutory authorities to accomplish suitable power supply to BSL-3 Laboratory, BSL-2 Laboratory & Animal Facility building including necessary modifications to be done in the existing electrical installation

Note:-

KSEI approved electrical scheme can be shared with the contractor upon request.

The rating of breakers, size of incoming & outgoing cables etc shall be done as per the actual requirements.

### **3. SCOPE OF WORK**

#### **I. Electrical services**

- a. Modifications in the existing substation of building 1B to bring power supply to BSL 3, BSL 2 and Animal House facility as mentioned in the above section
- b. SITC of LT cable from existing substation to the main panel located in the electrical room of BSL 3, BSL 2 and Animal House facility including RCC cable trench, Hume pipe, GI pipe and allied works as per directions of HITES/Client
- c. Main Electrical panel in the electrical room of BSL 3, BSL 2 and Animal House facility with 100% backup power supply through a new dedicated 400kVA Diesel Generator Set.
- d. Hybrid capacitor cum Harmonic panel to compensate the additional power demand

- e. LT cables between Main LT panel & other panels within the proposed BSL 3, BSL 2 and Animal House facility.
- f. Control cable for the smooth functioning of protection system / change over functions / metering & indicating functions
- g. Hume pipe / GI pipe for Cable entry to Main Electrical room of the proposed BSL-3 Laboratory, BSL-2 Laboratory & Animal Facility building
- h. Internal & External electrification work
- i. Electrical panels catering Light & Power (Raw & UPS), Indoor AC units, Ventilating fans
- j. Power supply arrangement for equipments supplied by client
- k. Power supply arrangement to HVAC system (high side), Lifts & Firefighting systems
- l. Power supply for Water supply system / Drainage system / Sewerage / Rain water lifting system as required
- m. Power supply for ELV works
- n. Vertical & Horizontal Distribution Boards for various services
- o. Cables from floor panel boards to Distribution Boards
- p. Cable tray / Trunking
- q. Energy efficient LED Light fixtures of minimum luminous efficacy as stipulated in the guidelines
- r. Energy efficient 5 star rated ceiling fans, Exhaust fans (wall / window mounted)
- s. Wiring Devices – Different colour switches and sockets for RAW & UPS power services
- t. UPS & SMF Battery system
- u. Earthing system
- v. Lightning Protection System
- w. External lighting for roads & parking areas as applicable
- x. Lighting automation for common area like corridors, toilets using occupancy/movement /PIR sensors
- y. Liaisoning work with authorities in obtaining approvals/ permissions/ sanctions /NOCs for energisation of power supply for the project
- z. Liaisoning work to obtain NOC from Local Fire dept

## II. ELV Services

- a. Addressable type Fire Alarm System
- b. Public Address System
- c. Fire fighters telephone system
- d. IP based CCTV System
- e. IP Based Access Control System
- f. Telephone System

- g. Network System
- h. Building management system

#### **4. DESIGN STRATEGY**

##### **I. Electrical services**

###### **a. Distribution boards**

Power and lighting panels for containment and non-containment spaces must be separate. All main distribution panels should be located outside containment space for ease of maintenance.

###### **b. Conduit laying**

All the inside and outside opening of the conduit, running from non-containment area to containment area and across different containment areas having differential negative pressure should be sealed to prevent circulation of air. Sealing should be done at accessible space for inspection and maintenance.

###### **c. Light fixtures**

All lights should be energy efficient, as per Energy Conservation Building Code. Lighting should be in the range of 300 - 500 lux in the laboratory, 700-800 lux in cleaning cycle area and for other functional areas as per NBC, NLC and ECBC codes.

###### **d. Power backup**

Signage, emergency lights, BMS, communication network, Access control, CCTV and IVC exhaust system should be provided with on-line UPS with minimum 30 minutes backup. The capacity of UPS shall be designed on the basis of emergency load of the facility.

A standby generator (DG set) with AMF panel capable to bear 100% load of the facility should be provided and connected with the main electrical panel of the facility

Electrical load may be properly calculated during the design stage, by keeping in mind, any future addition of equipment(s).

##### **II. ELV service**

###### **a. Access control system:**

Access Control system will be magnetic door type controlled through Card readers and biometrically. All sensitive and restricted areas shall be provided with Access Control System. Each Controller will control four nos

of Magnetic locks which can be for single or double leaf door. The centralized control will be managed through a server to be installed in main Security Control/ Server Room. For Overriding purpose Push Button will be provided inside the rooms. The change rooms shall be provided with privacy switch to dis-allow entry from any of the channel doors till the privacy switch is de-activated. The system will be capable to record the Entry/Exit transactions of the authorized personnel and the records will be stored in server

Suggestive requirement of Access Control system is provided in tender drawings.

b. Network

The laboratory should be equipped with communication network between containment area and outside support area LAN network should be provided for electronic transfer of information and data within the containment laboratory as well as from containment laboratory area to outside area. Electronic transfer of information and data should be encouraged, while avoiding paper transfer. The Data points in the BSL-3 Laboratory shall be provided fully wired with CAT6 cable complete with output terminals. The communication network shall be extended through existing IPABX in IAV building and shall be integrated with the BSL-3 Laboratory building.

c. CCTV system

CCTV system should cover all areas except toilet and changing area to monitor the working from outside the containment area. CCTV System, complete with wall/ceiling mounted high resolution color cameras, NVR, LED color monitor, associated power and control cabling along with required hardware and software, shall be provided. In addition to the laboratory area, the video surveillance shall monitor activity outside of the secured space including hallway entrance.

Suggestive requirement of CCTV camera locations is provided in tender drawings.

d. Building Management System

BMS shall be designed to monitor and maintain desired room conditions like pressure, temp and relative humidity and complete HVAC system operation, data archiving from Autoclaves & BLEED plant etc. VFDs should be connected to the directly controlled customized BMS along with controllers, cloud based monitoring, sensors and control dampers, human machine interface unit, cabling interconnecting the units and integrator units for the Programmable

Logic with remote display of alarm / parameters shall be designed to remotely monitor and supervise all functions, equipped with appropriate alarms.

## **5. CODES AND STANDARDS – ELECTRICAL & ELV SERVICES**

Following codes and standards have to be followed during design, execution and procurement of the project: -

- a. Central Public Works Department (CPWD) 2013 Part I / IS codes – Internal wiring regulations
- b. Central Public Works Department (CPWD) 2003 Part III – for Lifts & Escalators
- c. Central Public Works Department (CPWD) 2013 Part IV – for substation design
- d. National Building Code (NBC) 2016
- e. Indian Electricity Rules (IER)2010
- f. National Electric Code (NEC) 2011
- g. National Lighting code (NLC):2010& IS 3646 latest revision – Lighting Design
- h. Kerala State Electrical Inspectorate guidelines latest version – Protection, Wiring & Safety guidelines for Electrical installations
- i. Kerala State Electricity Board guidelines latest version
- j. IEC regulations for wiring & installations, 7th Edition revised version
- k. BEE guidelines – Energy conservation
- l. KSECBC:2017 guidelines – Energy conservation
- m. IS 3043 2018 – Earthing system design and materials
- n. IEC 62305-1:2010 – Lightning protection system design and materials
- o. Indian Electricity Act 2003
- p. IEC /CPRI/ERDA guidelines – Circuit breakers/ Electrical Panel Board design, Fabrication & Testing
- q. UL guide lines / BS 5839 / NBC-2016 / NFPA 72/ IS – 2189 – Fire alarm & control system
- r. UL/FCC /CE /BIS /IEC/ONVIF standards – IP based CCTV system

## **6. EPC CONTRACTOR’S SCOPE OF WORK-DESIGNS & DRAWINGS**

Following details shall be prepared and submitted to EIC for approval before commencing the execution work:



1. Detailed design of lighting (internal & external) by employing Dialux software
2. Preparation of room wise light fixture schedule and layout
3. Light points fed from Raw power & UPS power shall be separately mentioned in the layouts
4. Preparation of lighting layouts (both raw & emergency lights)
5. Selection & allocation of suitable power sockets for services which include work stations, WIFI points, indoor AC units, ventilating systems, lab equipments, equipments to be supplied by the client, general purpose sockets in all rooms, power points for ELV systems
6. Power points fed from back up supply (DG set or UPS) shall be separately mentioned in the layouts
7. Preparation of power layouts and power load calculation sheets separately for raw & emergency power points
8. Preparation of power supply distribution system for high power rated equipments coming under HVAC system (low side & high side), ventilation system, Firefighting system, plumbing system, Bio medical system including cable sizing, panel board sizing, cable containment system sizing, Cable trench / Hume pipe / GI pipe details
9. Preparation of power distribution system including the following:
  - Panel board/DB design
  - Incoming & outgoing breaker capacity calculations
  - Cable selection calculations
  - Tray selection calculations
  - Voltage drop calculations
  - UPS capacity calculation
  - UPS battery backup calculation
  - Single line diagrams
  - DB schedules
  - Floor wise power distribution layouts (lighting & power and other services).
10. Capacity calculations of substation equipments, Main LT panel sizing, Capacitor cum Harmonic panel sizing, connected load calculation sheets, single line diagrams for the submission for KSEB/KSEI approval, External and internal cable trench/Hume pipe details, Earthing system, Power supply intake arrangement etc.
11. Preparation of earthing system which include the following:
  - Conducting soil resistivity test for the location by appointing authorized agency
  - Fault calculation
  - Earthing pit & earthing conductor sizing calculations, Internal and external earthing system layouts.
12. Preparation of lightning protection system design based on risk analysis complying IEC guidelines, LPS layouts calculation sheets.
13. Surge Protection Devices as per risk analysis as applicable

14. Detailed electrical load breakup of the project including connected load (essential & non-essential separately) of each equipment/item (light, power points, AC points, load of all mechanical & equipments to be supplied by the client, UPS, any other service equipments' load etc.
15. Single line diagrams of floor wise distribution boards/ panel boards, Main LT panels/Essential/capacitor panel details, cable details etc.
16. Relevant documents supporting the electrical load details of mechanical/Lab equipments/other essential equipments from OEM shall be submitted to EIC along with above.
17. External service layout of electrical services (routing of cables from existing sub stations and DG sets) to building, RCC trench/Hume pipe/GI pipe/Manholes etc, Street light/landscape/facade layout, details of cable & trench for street light, location of light control panels etc.
18. Material make approval & procurement may be proceeded after getting approval from EIC for the above.
19. Preparation of GFC drawings/Conduit layouts of all electrical services
20. Preparation of make approval requests, work inspection requests etc. as per approved construction program
21. Preparation of As built drawings
22. Preparation of O & M manuals

## **7. EARTHING NETWORK**

EPC Contractor shall get the soil resistivity test done at his own cost of the area, prepare fault calculation, earth pit and conductor type & size design calculations as per relevant regulations/guidelines.

Based on these calculations, EPC contractor shall submit the earthing system drawings to Local Electricity Authority/Kerala State Electrical Inspectorate and get the approval before commencement of material procurement.

Tinned copper earth strips and copper electrode earth pits shall be provided for Body & Neutral Earthing of all electrical equipment in the Substation area as per IS 3043:2018 and CPWD Specifications. Tinned copper earth strips and copper electrode earth pits shall also be provided for all utility equipments.

Earthing shall be carried out for all power distribution system and effectively bonding the equipment. Separate and distinct earthing with Tinned copper electrode earth pits and suitable size Tinned copper earthing strips shall be provided for critical equipments.

The net earth resistance of the earth grid shall meet the specified value as per IS 3043:2018

Earthing system for the following equipment shall be done as per OEM's recommendations:

- UPS system – Body & Neutral
- LV works
- Laboratory Equipments

However, GI strip shall be employed to achieve earth continuity between main LT panel and floor electrical panels to be fixed in the cable tray connecting main electrical room with other floors.

Suitable sized Elastomeric Safety Mats with shall be provided for all HT & LT Panels installed in the substations and all buildings, as required.

All three phase electrical installations shall be provided with double earth connection and single-phase electrical installations with one earth connection as per CPWD specifications & NBC 2016.

## **8. CABLING AND WIRING**

The design, manufacturing, testing and supply of single core LEAD FREE FRLS PVC insulated 1.1 KV grade multi-stranded twisted wires under this specification shall comply with the latest edition of following standards.

IS: 3961: Current rating for cables.

IS: 5831: PVC insulation and sheath of electric cables.

IS: 694:PVC insulated cables for working voltage upto and including 1100 volts.

IEC: 754: FRLS PVC insulated cable.

Copper multi-stranded twisted conductor FRLS PVC insulated wires shall be used in conduit as per item of work.

The wires shall be colour coded R Y B, for phases, Black for neutral and Green for earth.

Progressive automatic in line indelible, legible and sequential marking of the length of cable in metres at every one metre shall be provided on the outer sheath of wire.

The material & insulation of wires shall be ROHS compliant (Reduction Of Hazardous Substance) and shall comply the following directivesCables

The design, manufacture, testing and supply of the cable under this specification shall comply with latest edition of following standards:

IS: 8130: Conductors for insulated electric cables and flexible cords.

IS: 7098: XLPE insulation and sheath of electric cables.

IS: 3975: Mild steel wires, strips and tapes for armouring cables.

IS: 7098: Current rating of cables.

IS: 7098: XLPE insulated (heavy duty) electric cables for working voltage upto and including 1100 volts.

IS: 424-1475(F-3): Power cable-flammability test.

Specification for cross-linked polyethylene insulated XLPE sheathed cable for working voltage upto 1.1 KV.

Specification for XLPE insulated (heavy duty) electric cables for working voltages upto and including 1100 volts.

#### External laying method

All armoured LT power cables, control cables, telephone cables, signal cables and cables for other LV system etc. shall be laid in suitably sized RCC trench with removable cover at required intervals for pulling of cables. RCC trench shall be constructed beside the roads & pathways at suitable depth as per CPWD specifications. Cables shall be fixed with GI clamps. 50% area of the trench shall be kept for laying of cables in future

#### Road crossing

Adequate no. of DWC HDPE Pipes / Hume pipes / GI pipes having suitable class & diameter with required quantity spare pipes shall be laid across the roads / pathways for all the cables under electrical & ELV system.

Suitable size manholes shall be provided at regular intervals. The RCC trenches shall have all necessary provisions for draining of water during the rainy season. The trenches shall be designed & made such that it should be neat & tidy free from accumulation of debris, water stagnation etc.

## **9. LIGHTING DESIGN & LIGHTING FIXTURE**

LED light fixtures shall be provided with an inbuilt harmonic suppression system (to achieve harmonic distortion less than 10%). The illumination level conforming to latest IS & NLC Code, NBC-2016, KSECBC: 2017 with all amendments and as per technical specifications.

Generally, all indoor LED lights shall have luminous efficacy minimum 100 L/w and outdoor LED lights shall have luminous efficacy minimum

Lighting Power Density (LPD) for various areas shall be as per lighting simulation requirements as per & KSECBC: 2017 norms.

Sufficient number of light fixtures connected with UPS backup power (depending on the requirement / criticality) shall be provided in all locations of the building to comply with NBC/CPWD guidelines.

EPC contractor shall prepare the illumination level calculation (based on IS/NLC/NBC/KSECBC:2017/ norms), selection of light fixture, room wise/ floor wise light fixture schedule to engineer in charge for approval.

The lighting layout shall be prepared only after the approval of illumination data sheet from EIC.

Lighting automation shall be achieved by means of occupancy/ movement sensors/ daylight sensors for common spaces like corridors, toilets and other spaces stipulated in relevant sections of NBC-2016, KSECBC: 2017 etc.

External light fixtures mounted on GI octagonal pole shall be proposed for internal roads, parking areas etc. Illumination in these locations shall be done such that there shall be no blind spot in the roads and parking areas. Street light fixture shall be weather proof type with minimum IP66 & Ik08 protection.

Height and spacing of GI pole shall be decided on the basis of CPWD/NEC. Power supply of the street lighting shall be fed from the dedicated street lighting control panel located in the electrical substation. ON/OFF control shall be achieved by means of timer & contactor arrangement within the street light control panel itself.

The material approval and procurement shall be followed after getting approval from EIC for illumination design, preparation of room wise/floor wise lighting layouts.

Note:-

Wattage of each light fitting shall be decided based on the dialux design

LED & Driver shall be BIS approved

All fixing accessories and hardware shall be included

Table given below shall be followed to select light fixtures in the locations mentioned

Sl No	Type of light fixture	Location of use	Technical specifications
-------	-----------------------	-----------------	--------------------------

	ft batten extruded aluminium body, surface IP 20	Corridor without false ceiling / Electrical room UPS room	surface type, IP 20, LED, Slim Extruded Aluminium batten fitting with <u>following minimum requirements:-</u> System lumen > 2000 lm, Luminous efficacy >100 lumen/ watt, CRI >80, Beam Angle: 120 Deg, Input voltage: 220-240Vac, 50/60Hz, CCT 5700K, Operating voltage range 90-300V, THD <10%, High surge Protection 2 KV, Average life L70 @ 50000 hrs, Operating temperature: 0°C to +45°C, Driver compliance IEC 62384, IEC 1547, IEC 61347-2-13,. The luminaire Manufacturer shall provide LM70 report from third party NABL accredited LAB and LM80 from LED Chip manufacturer.
	ft batten extruded aluminium body surface IP 20 suitable for wall mounting	Mirror light in wash area / surface light in WC room	similar to above, but 2ft long and THD < 15%
	ft x 2ft recessed mounted	Corridor with grid pattern false ceiling / Other rooms with false ceiling	Recessed type LED of 595 x 595 mm size with aesthetically designed Pressure Diecast alloy/CRCA housing & injection moulded PC component diffuser with <u>following minimum requirements:-</u> luminous efficacy > 100 lumen/ watt, CRI > 80, UGR<19, CCT> 700K, Inbuilt protection against short circuit, over voltage protection and surge protection of minimum 2 KV including connections etc, THD <10%, Driver efficiency > 85% , service life of 50,000 hrs @ L 70, Driver compliance IEC 62384, IEC 1547, IEC 61347-2-13.

2ft x 2ft, surface mounted, clean room fixture, IP 65 or better	<p><u>Ground floor (Animal Facility area):-</u> Clean corridor / Sterile store / Quarantine Room Procedure Room / Imaging room Changing Room /Air shower / Autoclave /Experiment / Breeding Room /Airlock corridor</p> <p><u>First Floor (BSL-3 &amp; BSL-2 lab area):-</u> Preparation room Change room Entrance Airlock Exit shower room Exit air lock Common corridor BSL-3 Virus lab 1&amp; 2 Animal holding area Procedure Room BSL-2 Laboratory Airlocks BSL-2 Lab corridor BSL-2 Laboratory Rooms</p>	Surface mounted Bottom opening clean room flat LED panel of 595 x 595 mm size fully lit diffuser with following minimum requirements:- CCT 5700K/6500K, luminous efficacy >100 Lumen/watt (minimum total lumen delivered package 5000), CRI> 80, THD<10%, Driver efficiency > 90%, Service life of 50,000 hrs @ L 70, Driver compliance IEC 62384, IEC 61547, IEC 61347-2-13 etc. complete as required
Down light, round type recessed/surface mounted, aluminium body	Staircase / Corridor / Rest room	Recessed type LED down lighter neutral white (4000 K) with LED saving pressure die cast aluminium ang body with following minimum requirements:- High efficiency diffuser with more than 85% transmittance, Rated life of L-70 @50000 hrs, lumen output better than 1150 lumens, luminous efficacy>100 lumen/ watt, CRI>80, Surge Protection >2 k, Driver efficiency > 90%, PF>0.98, THD<10 %, Operating Temperature 0°C to +45°C, Driver compliance IEC 62384, IEC 61547, IEC 61347-2-13) etc. complete as required
1ft batten extruded aluminium body, IP54 suitable plant room	Chiller plant room / Service room / AHU room / DG set shelter	LED weatherproof, opal diffuser in polycarbonate IP 65, 1100+/-100 mm fixture system lumen output of 500 lumens, CCT >4000K, efficacy >100 lumen/ watt, CRI> 80, THD<10%, Driver efficiency > 90%, Service life of 50,000 hrs @ L 70, Driver compliance IEC 62384, IEC 61547, IEC 61347-2-13 etc complete as required

	Bulk head LED light, IP66 suitable for outdoor application	Entry of the building	LED Bulkhead with a nominal system lumen output of 1000 lumens and following minimum requirements:- system efficacy >100 lm/W, rated system life time of 50,000 burning hours at L70, color temperature of 5700K/6500K, CRI > 80, SDCM<5, luminaire shall meet IP66 rating and IK 08 rating, THD< 10% at full load, PF > 0.9, 2 KV Internal surge protection, Driver compliance IEC 62384, IEC 1547, IEC 61347-2-13. The luminaire housing shall be made of high pressure die cast Aluminium with HET front diffuser.
	Street Light		LED weather proof, potted driver, rated voltage:220-240V, operating voltage: 150V - 270 V, in built surge protection: 6kV, power factor:0.95, operating temperature: upto 45deg, aesthetic and robust with pressure diecast aluminium body, UV stabilized IP PC lens, Luminous efficacy >140 lumens/watt, lamp life:50000 hrs, Driver compliance IEC 62384, IEC 1547, IEC 61347-2-13. These are minimum requirements

## 10. LIGHTNING AND SURGE PROTECTION SYSTEM

Lightning protection shall be provided as per IS/ IEC 62305-1:2010 (latest as amended), CPWD Specifications and NBC 2016 norms. The main and most effective measure for protection of structures against physical damage is considered to be the lightning protection system (LPS).

An external LPS which consists of air-termination system, down-conductor system and earthing system is intended to:

- Intercept a lightning flash to the structure (with an air-termination system),
- Conduct the lightning current safely towards earth (using a down-conductor system), and
- Disperse the lightning current into the earth (using an earth-termination system).

Accordingly, a standard lightning protection system will be provided as per IS/ IEC – 62305: 2010 & NBC 2016 Standards using single prone finials, horizontal and down comer earthing strips of suitable size, terminating in the earth pits, test link in



suitable box, interconnecting all the earth pits with suitable size SS/ copper / GI earth strip laid underground etc.

Surge protection system as per IEC 62305-1:2010/NBC-2016/ Electrical Inspectorate/ Electrical Board norms shall be provided in the electrical system (electrical panels, distribution boards (DBs) etc). The surge protection system has to effectively intercept the lightning current entering the electrical system through underground systems & services and the surge occurring within the electrical system.

EPC contractor shall design lightning protection system as per relevant standards and submit the system drawings and calculation to Local Electricity Authority/Electrical Inspectorate for their approval.

Material procurement shall commence only after getting approval for the same. Copy of all documents shall be submitted to engineer in charge.

Aviation Obstruction Light (AOL) shall be provided as per Civil Aviation regulations, NBC-2016 norms & CPWD Specifications as applicable. All Aviation Obstruction Lights shall be fed with UPS/ emergency power supply.

## **11. UNINTERRUPTED POWER SUPPLY**

UPS back up shall be provided for the following:

- |                 |   |  |
|-----------------|---|--|
| a. Lighting     | - | 50% of the lighting in all areas                                 |
| b. Power points | - | Sockets catering Computer points                                 |
|                 |   | Building Management System                                       |
|                 |   | CCTV system  |
|                 |   | Access control system  |
|                 |   | Individually ventilated cages                                    |
|                 |   | Pass box door electromagnets                                     |
|                 |   | Power supply for Lab equipments as per recommendations of client |
|                 |   | Sockets for critical applications                                |

UPS units suitable for 3-phase power supply IN/OUT, True online, modular type, 3 Level IGBT Inverter Technology shall be provided.

The UPS shall be Modular type, Fault Tolerant and shall provide a regulated and uninterrupted three-phase AC power, within specified tolerances, to critical station loads during normal and emergency operations with latest 3 Level IGBT Inverter Technology and UPS input to be provided for uninterrupted power supply for all Emergency requirements with Battery monitoring system.

The capacity of the UPS for critical lab system shall be of minimum 30kVA and for lighting the capacity shall be of minimum 5kVA.

Isolation transformer shall be with copper winding, external type, enclosed in a separate enclosure of suitable size and the product shall be BIS certified.

UPS with separate Power distribution system (comprising distribution panels, rising mains, distribution boards, incoming isolators etc.) shall be provided.

The UPS System shall be for 30 Min Backup (on 100% capacity of UPS) with Heavy duty Sealed Maintenance Free batteries with highest efficacy for the latest sophisticated UPS system. The UPS system shall have a Bypass system also. The system shall have the incoming and outgoing switchgear panel.

Minimum features of UPS are mentioned below:

1.	Input/Output	:	3 phase
2.	Characteristic	:	true online
3.	Technology	:	3 level IGBT
4.	Battery management system	:	Required
5.	Input power factor	:	0.99
6.	Output power factor	:	Unity
7.	UPS efficiency	:	> 95%
8.	No load losses	:	As per IEC rules
9.	Input THDi at any load	:	< 5%
10.	AC volt accuracy	:	+/- 1%
11.	Transient voltage regulation	:	+/- 5%
12.	Transient recovery time	:	< 20 milliseconds
13.	Total voltage distortion	:	< 1% for linear load
14.	Total voltage distortion	:	< 5% for non linear load
15.	Isolation transformer	:	required only for 30kVA UPS and to be BIS certified manufacturer
16.	Accoustic noise level	:	< 55dBA
17.	BMS	:	Backnet/Modbus/similar connectivity

The following works fall in the scope of UPS supplier: -

- Cables for input and output power supply from raw power panel & to UPS fed panels
- Isolator in the incoming & outgoing side of UPS
- Communication card for data monitoring on BMS System.
- Power cables shall be single core multi strand copper flexible type

The requirements mentioned have to be verified during detailed design and EPC contractor shall consider any other essential services which require back up power may also be included.

EPC contractor shall submit the load calculation sheet of UPS units assigned for building or specific service as per the design including details of load of each equipment/item connected to UPS to EIC for approval.

## 12. EXTERNAL/ STREET LIGHTING

External street lighting design shall comply with IS /NLC/ECBC//NBC2016 specifications.

Location to be as follows:

- Parking areas
- Internal roads

The lighting control/operation for external Lighting shall be controlled by a street lighting panel working on timer and contactor arrangement operated from the control panel itself.

There should not be any dark area for the hassle-free movement of vehicles/ people after the completion of construction work in this scope of contract.

Light fixtures shall be weather proof type minimum (IP-66) and tamper proof IK08 having anti yellowing diffuser.

Street Light Poles shall be made out of Galvanized Iron (GI) Octagonal tubes. Poles will be suitable for single/ double side arms or as required. Poles shall have a service window at the bottom comprising connector terminal & MCB.

Poles shall be mounted on foundation with Anchor bolts of suitable size & quantity.

RCC foundation design shall be submitted for EIC's approval considering wind load also.

The height & spacing of the LED street light poles pole will be designed to achieve illumination level as per CPWD/NBC/NLC guidelines. The poles shall be earthed with suitable size GI / copper SWG wire and necessary earth pits shall be provided. The height & spacing of pole and illumination level shall comply with CPWD Specifications, NBC 2016 and other relevant norms.

The cable to be used for external lighting shall be armoured XLPE type and to be laid underground.

### **13. FIRE ALARM SYSTEM**

Addressable Intelligent fire detection and Alarm system of latest technology with modular type fire alarm panels, multi sensor detectors, smoke detectors, heat detectors, beam detectors, response indicators, manual call point and hooters, light strobe, control modules, monitor modules, isolator modules etc. shall be provided as applicable.

The system shall meet the requirements of EN54/ UL / NBC-2016 / CPWD Specifications/ State By laws. License/Approval of Local Fire Authorities shall be obtained by the EPC contractor, provided for the complex.

It shall be possible to integrate a public address system with a fire alarm control panel.

There shall be the proper Zoning within the building considering the non-critical & critical areas. Appropriate Fire Alarm Panel with 20% spare capacity in each loop and repeater panel shall be provided as required.

The monitoring of the whole complex shall be in the Main Fire Control room located in the ground floor of the facility.

Fire Alarm control Panel shall be modular type and has capability to accommodate minimum 99 devices and 99 detectors in one loop or combination of 198 numbers of both detectors and devices per loop.

The system features shall be as follows:

The system and its components shall comply UL or BS 5839 standards

The devices/detectors of the system shall be hard or soft addressing type

The fire alarm control panel shall be addressable type, Alpha numeric QWERTY key pad type / LCD type with battery backup for 24 hrs normal operation and 30 minutes alarm operation on main power failure, microprocessor modular type, loop cards shall be as per site requirement with 20% spare loop, communication card, BMS interface module (BACKNET/MODBUS or any other means).

Detectors shall be installed as per coverage defined in NBC-2016/ NFPA 72/ IS – 2189 code. It should include all rooms including plenum areas utilized as part of the HVAC system.

Suitable numbers of input/output (C/M) relay modules are to be provided for connecting other equipment like lifts, fire fighting system, AHUs, Ventilation system, PA system etc.

Monitor modules shall be provided to supervise the operation of tamper switches fitted in the fire fighting shafts

Spacing between two detectors shall not be more than 8m in corridors of width upto 3 mtrs and for other areas as per NBC 2016/CPWD guidelines.

Cabling shall be with Fire Survival armoured category armoured copper cable as per NBC-2016.

Addressable manual call boxes/Sounders/Strobes shall be provided near all exits, stair cases, lift lobbies etc. as per NBC 2016/NFPA guidelines. The distance between different locations of manual call points/Sounders/Strobes shall comply with relevant norms.

The response indicator shall be used as per the norms and requirements.

The fire alarm control panel shall be located in the fire control room.

Fire Alarm System shall be integrated with the PA system at the Fire Control room. Two Way communication Fire Fighters Telephone Jack & Handset with necessary accessories are to be provided. Location of Fire fighters telephone jacks shall comply with NBC 2016/NFPA guidelines.

The fire alarm system shall have facility to integrate talk back Fire Fighter telephone System.

Fire signages shall be provided at the appropriate locations satisfying all the norms & requirements.

Integrations with other services like (HVAC, Lifts etc) shall be provided with the Fire Alarm System as per NBC 2016/NFPA guidelines.

EPC contractor shall submit floor wise fire detection and alarm system layouts of the building to EIC and get it approved before commencement of material approval and procurement.

EPC contractor shall submit “cause and effect matrix” of the system for the entire campus and submit the same to EIC for approval.

EPC contractor shall forward the system drawings to the local fire department and get it approved at his cost.

Proposed fire alarm panel shall be connected to the fire alarm panel in the existing IAV building

#### **14. FIRE FIGHTERS TALK BACK SYSTEM**

The system shall consist of fire fighters telephone jack, firefighters telephone handset, control console and cabling.

The system components shall comply with EN 54 standards.

The location of FF telephone jack shall be generally at the landing of every fire escape staircase and FF telephone handsets shall be in the control room.

The system shall be made operational in case of a fire incident in the building.

#### **15. DATA NETWORK SYSTEM**

The scope of work includes data RJ45 sockets with back boxes, CAT 6 UTP wiring in appropriate conduits, patch panel, Ethernet switches, both Fibre & CAT 6 patch cords, PDUs, LIUs network racks, interconnection between network racks, cable support system etc.

RJ 45 data outlets points shall be provided for network points (wherever work stations are required in all floors), Wi-Fi points, Access control system, Information Display system etc. as per requirement of the client in rooms and other areas.

The Data outlet points shall be connected to the nearest network rack by using 4 pair UTP CAT-6 wire laid in Raceways, recessed / surface conduit as required.

Conduit of 25 mm dia. minimum size shall be used for laying CAT6 cable in the data system.

Maximum 3 nos of CAT6 cables are allowed in a single 25 mm dia conduit.

UPS Power supply shall be provided wherever Data outlet points are to be proposed.

The maximum length of the CAT-6 cable from end user point to the Network rack / Edge switches shall not be more than 90m. Beyond 90 mtrs, optical fiber cable shall be used

Sufficient number of network racks (including Patch panels, Ethernet switches, PDUs etc.) have to be located in each floor based on the maximum possible length of CAT6 wire from the utmost data outlet located in each floor.

There shall be 10% spare for future connection in all patch panels and switches

The network panel at various floors will be connected individually to the Main rack of the building/ block with OFC cable through conduit or raceways on surface/ recess. LIUs, Fiber patch cords shall be provided as per requirements.

The network panel comprising of jack/Patch panels, Network switches, patch cords, power supply units, cooling fans, wire managers, LIUs, Trans-receivers, Fiber patch cord etc. in each floor shall be provided as per the requirement

Service provider for network systems shall terminate their cable and other equipments in the central control room.

EPC contractor shall submit floor wise data system layouts/Riser diagram mentioning location of Data points provided for different services as well as other LV systems, location of racks details of patch panels, Ethernet switches, connectivity of floor racks to main rack, details of main rack in ground floor, server etc to engineer in charge for approval.

Material procurement may commence on approval of these layouts from EIC.

## **16. TELEPHONE SYSTEM**

The scope of work includes RJ11 telephone sockets with back boxes, 2 pair telephone wire from outlet to terminal blocks(TTB) in each floor, TTBs with terminal block in each floor, multi pair unarmoured telephone cable from each floor to Main Distribution Frame in central control room located in ground floor.

2pair telephone wire shall be laid from each telephone outlet to the floor telephone terminal block (TTB) located in each floor of each building.

Terminal block shall be installed in lockable metallic boxes with proper tagging/labelling.

Multi pair telephone wire shall be laid in appropriate type raceways through the LV shaft from each floor to the main terminal block (MDF) located in the control room at the first floor.

## **17. INTEGRATION OF TELEPHONE SYSTEM WITH EXISTING IPABX**

The EPC Contractor shall study the existing IPABX system installed in IAV and shall integrate the telephone/communication system of BSL-3 Laboratory, BSL-2 Laboratory and Animal Facility building with the existing IPABX system.

**18. PUBLIC ADDRESS SYSTEM (IF REQUIRED AS PER NBC OR ANY OTHER STATUTORY GUIDELINES/STANDARDS)**

Public Address System shall be planned, designed and provided in the BSL-3 Laboratory building, if required as per NBC or any other Statutory guidelines/standards.

The System shall be catering the public address and emergency announcement for building.

The proposed PA system consists of voice control station, call station with key pad, micro phone at control station, amplifiers, ceiling or wall mounted speakers, zone selector, speaker cabling, Rack etc.

The system distributes background music, live speech, and evacuation messages.

The PA system shall be public address sound management system with system objective to allow announcement from more than one location having facility to play music during idle time.

Paging facility shall also be provided to facilitate Zone wise announcement or ALL CALL as the case may be.

The system shall be public address cum emergency sound systems compliant to international standards for Public Address, Evacuation and emergency sound systems.

The Centralized PA / BGM System with a suitable SPL of 75 dB - 80 dB +/- 3dbA should be considered. The complete area should be divided into suitable zones and zone wise announcement shall be possible from central control station.

The PA system shall comprise of the following:

- Call station with Microphone and zone selection Keys.
- Voice alarm controller
- Voice alarm router
  - Speakers, ceiling or wall mounted type in waiting areas, corridors, lobbies, nurse stations etc.
- Amplifiers
- Zone selectors
  - Rack housing the control system distribution network / cables and required components and accessories

## **19. IP BASED CLOSED CIRCUIT TELEVISION SYSTEM**

The scope of work include IP Based Dome Cameras, Bullet Cameras and PTZ cameras for surveillance, PoE switches, NVR, Video management system software, Storage hard disks, LED display units, Racks, Server PC, Joystick for PTZ functioning, Cabling using CAT 6 UTP cable, cable containment system etc.

The minimum requirements of the system are 30 FPS and 2mega megapixel for the video management system at the control room

The system offered must be capable of simultaneous viewing, recording and playback facility. All components to be used must be compatible for high definition & high-resolution capability. The system shall be IP based and capable of viewing from multiple locations using appropriate web-based applications for remote monitoring apart from viewing in the monitor provided in the control room. The types of cameras & locations of various cameras indicated herein are minimum to be provided. However, during detailed designing if required and found necessary the type/ rating of the cameras shall be upgraded.

Locations of cameras are mentioned below:

- All locations in the facility except toilets and change room

Codes and Standards are as follows:

Products shall comply with UL/ FCC /CE /BIS /IEC/ONVIF standards

Design & Installation guide lines shall be referred from latest NBC/CPWD regulations.

Dome cameras shall be minimum 4MP, 30 FPS, CMOS type, IP 66, vandal proof, night vision IR LED type, minimum IR distance of 30 mtrs.

Bullet cameras shall be minimum 4MP, 30 FPS, CMOS type, IP 66, vandal proof, night vision IR LED type, minimum viewing distance of 40 mtrs.

PTZ cameras shall be CMOS type, minimum optical zoom 30X, vandal proof, IR LED type and minimum viewing distance of 300 mtrs.

Sufficient number of LED display units shall be provided with minimum resolution of 1920 x1080 pixels and size of display to be minimum 44 inch.

Network Video Recorders shall be used considering the total number of cameras with minimum 10% spare capacity and shall support simultaneous recording, playback and viewing without compensating the picture quality shall be embedded with video management software to fulfil the smooth functioning of the system. The video management software shall be from OEM only.



Cabling shall be done by using UTP 4 pair CAT 6 cable for cameras drawn in 25 mm conduits. Cable shall be terminated in PoE switches installed in the rack. The maximum distance of CAT6 cable shall be limited to 80 mtrs.

Number and location of network racks shall be selected such that the minimum distance of CAT6 cable is maintained from each camera to the network rack.

30 days' storage capacity shall be designed for calculating hard disk size.

There shall be provision for connectivity between proposed system with surveillance system in the existing IAV building.

## **20. ACCESS CONTROL SYSTEM**

The access control system shall be IP based and proposed to restrict the traffic in some areas for public and entry for designated staff only.

The system consists of biometric/magnetic card readers at entry/exit of doors, emergency push button for exit, electromagnetic lock, door controller, master controller, software and server, printer etc. the system shall be IP based.

Access control system is proposed for locations where entry has to be restricted. The tentative requirement of access control system is given tender drawings for bidders reference.

Each Controller will have magnetic locks of single or double leaf door.

The centralized control will be managed through a server to be installed in central control room.

For overriding purpose, Push Button will be provided inside the rooms near the access controlled doors.

EPC contractor shall prepare a riser diagram showing position of doors to be controlled, door controller, server etc. to Client's/EIC's approval.

Material make approval & procurement may be proceeded only after EIC; approval

## **21. BUILDING MANAGEMENT SYSTEM**

Main features:

The EPC Contractor shall carry out Design, Engineering, Supply, Installation, Testing & Commissioning of IP based BMS Works.

Proposed BMS system shall be logically structured into three distinctive levels, which are Management Level, Automation Level and Field Level. Each level shall be autonomous from the other.

Peer to peer communication shall be possible on all system levels and the system design shall be modular in structure to allow straightforward extensions.

Necessary hardware/software required for hooking up the BMS system shall be provided.

BMS shall be designed to monitor and maintain desired room conditions like pressure, temp and relative humidity and complete HVAC system operation, data archiving from Autoclaves & BLED plant etc.

The system shall be modular in nature and shall permit expansion of both capacity and functionality through the addition of field devices / programming.

The failure of any single component or network connection shall not interrupt the execution of control strategies at other operational devices.

Comprehensive I/O summary with relevant A/I, A/O, D/I, D/O details for all equipment and systems covered under BMS, System Architecture, Interconnectivity between buildings etc. shall be prepared by EPC contractor during detailed engineering & as per directions of Engineer in charge.

Material make & procurement may be proceeded after getting approval from EIC of System Architecture, I/O summary, Interconnectivity details.

## 22. ROOM WISE POWER, DATA & VOICE POINTS

### GROUND FLOOR

#### Room Wise Power, Data & Voice Points List GROUND FLOOR

ROOM NAME / DESCRIPTION	Power Switch Socket		Data		Voice	
	Min. Qty	Type	Min. Qty	Type	Min. Qty	Type
Lobby	4	Modular	1	Modular	1	Modular
Office	12	Modular	3	Modular	3	Modular
Staff Room	12	Modular	3	Modular	3	Modular
Rest Room Male	2	Modular				
Rest Room Female	2	Modular				
DA Toilet	2	Modular				
1.5M Wide Corridor	3	Modular				
Receiving Area	2	Modular			1	Modular
2.35M Wide passage	2	Modular				
AHU Room	2	Modular				
CHR 1	2	Modular				
Shower						

<b>CHR 2</b>	<b>2</b>	<b>Modular</b>				
<b>BSL – 3 ED Room</b>	<b>6</b>	<b>Modular</b>	<b>2</b>	<b>Modular</b>	<b>1</b>	<b>Modular</b>
<b>Incoming Store</b>	<b>4</b>	<b>Modular</b>				
<b>Cage Wash</b>	<b>4</b>	<b>Modular</b>	<b>1</b>	<b>Modular</b>	<b>1</b>	<b>Modular</b>
<b>1.8M Wide Corridor</b>	<b>2</b>	<b>Modular</b>				
<b>2.2M Wide Dirty Corridor</b>	<b>3</b>	<b>Modular</b>				
<b>Quarantine Room</b>	<b>6</b>	<b>Modular</b>	<b>1</b>	<b>Modular</b>	<b>1</b>	<b>Modular</b>
<b>Air Lock</b>	<b>1</b>	<b>Modular</b>				
<b>Exit</b>	<b>2</b>	<b>Modular</b>				
<b>DE gowning</b>	<b>2</b>	<b>Modular</b>				
<b>Gowning</b>	<b>2</b>	<b>Modular</b>				
<b>Entry</b>	<b>1</b>	<b>Modular</b>				
<b>Procedure Room 1</b>	<b>8</b>	<b>Modular</b>	<b>2</b>	<b>Modular</b>	<b>1</b>	<b>Modular</b>
<b>Procedure Room 2</b>	<b>8</b>	<b>Modular</b>	<b>2</b>	<b>Modular</b>	<b>1</b>	<b>Modular</b>
<b>Procedure Room 3</b>	<b>8</b>	<b>Modular</b>	<b>2</b>	<b>Modular</b>	<b>1</b>	<b>Modular</b>
<b>Imaging Room</b>	<b>8</b>	<b>Modular</b>	<b>2</b>	<b>Modular</b>	<b>1</b>	<b>Modular</b>
<b>Clean Store</b>	<b>4</b>	<b>Modular</b>		<b>Modular</b>	<b>1</b>	<b>Modular</b>
<b>Autoclave Loading Bay</b>	<b>2</b>	<b>Modular</b>	<b>1</b>	<b>Modular</b>	<b>1</b>	<b>Modular</b>
<b>Breeding Room 1</b>	<b>8</b>	<b>Modular</b>	<b>2</b>	<b>Modular</b>	<b>1</b>	<b>Modular</b>
<b>Breeding Room 2</b>	<b>8</b>	<b>Modular</b>	<b>2</b>	<b>Modular</b>	<b>1</b>	<b>Modular</b>
<b>Breeding Room 3</b>	<b>8</b>	<b>Modular</b>	<b>2</b>	<b>Modular</b>	<b>1</b>	<b>Modular</b>
<b>Experiment Room 1</b>	<b>8</b>	<b>Modular</b>	<b>2</b>	<b>Modular</b>	<b>1</b>	<b>Modular</b>
<b>Experiment Room 2</b>	<b>8</b>	<b>Modular</b>	<b>2</b>	<b>Modular</b>	<b>1</b>	<b>Modular</b>
<b>Experiment Room 3</b>	<b>8</b>	<b>Modular</b>	<b>2</b>	<b>Modular</b>	<b>1</b>	<b>Modular</b>
<b>Experiment Room 4</b>	<b>8</b>	<b>Modular</b>	<b>2</b>	<b>Modular</b>	<b>1</b>	<b>Modular</b>
<b>Experiment Room 5</b>	<b>8</b>	<b>Modular</b>	<b>2</b>	<b>Modular</b>	<b>1</b>	<b>Modular</b>
<b>1.8M Wide Clean Corridor</b>	<b>2</b>	<b>Modular</b>				
<b>Air Lock</b>	<b>1</b>	<b>Modular</b>				
<b>1.5M Wide Dirty Corridor</b>	<b>3</b>	<b>Modular</b>				
<b>Storage</b>	<b>4</b>	<b>Modular</b>		<b>Modular</b>	<b>1</b>	<b>Modular</b>
<b>MGPS Room</b>	<b>6</b>	<b>Modular</b>		<b>Modular</b>	<b>1</b>	<b>Modular</b>
<b>UPS Room</b>	<b>6</b>	<b>Modular</b>	<b>1</b>	<b>Modular</b>	<b>1</b>	<b>Modular</b>

Electrical Room	6	Modular	1	Modular	1	Modular
DG Shelter	2	Modular				Modular

### **Room Wise Power, Data & Voice Points List First Floor**

ROOM NAME / DESCRIPTION	Power Switch Socket		Data		Voice	
	Min. Qty	Type	Min. Qty	Type	Min. Qty	Type
2.6M Wide Corridor	2	Modular		Modular		Modular
1.8M Wide Corridor	2	Modular		Modular		Modular
BSL-3 AHU Utility Room	8	Modular	1	Modular	1	Modular
BMS Room	10	Modular	2	Modular	1	Modular
Store	4	Modular				
Autoclaving	4	Modular	1	Modular	1	Modular
LAB In charge Room	6	Modular	2	Modular	1	Modular
Air Lock BSL-2	1	Modular				
1.8M Corridor	2	Modular				
BSL – 2 Lab 1	10	Modular	2	Modular	1	Modular
BSL - 2 LAB 2	10	Modular	2	Modular	1	Modular
BSL – 2 Lab 3	10	Modular	2	Modular	1	Modular
Serology Lab	10	Modular	2	Modular	1	Modular
Serology Lab A/L	1	Modular				
1.8M Wide Corridor	2	Modular				
CHR 1	1	IP66 Rated				
Shower						
CHR 2	2	IP66 Rated				
BSL-3 Virus Lab 1	12	IP66 Rated	2	IP66 Rated	1	IP66 Rated
Material Transfer	2	IP66 Rated			1	IP66 Rated
BSL-3 Virus Lab 2	18	IP66 Rated	2	IP66 Rated	1	IP66 Rated
Air Lock	1	IP66 Rated				
Loading Room	2	IP66 Rated	1	IP66 Rated	1	IP66 Rated
Unloading Room	2	IP66 Rated	1	IP66 Rated	1	IP66 Rated
1.8M Wide Corridor	2	IP66 Rated				
CHR 1	1	IP66 Rated				
Shower						
CHR 2	2	IP66 Rated				
Animal Hold	8	IP66 Rated	1	IP66 Rated	1	IP66 Rated
Material Transfer	2	IP66 Rated	1	IP66 Rated	1	IP66 Rated
Procedure Lab	8	IP66 Rated	1	IP66 Rated	1	IP66 Rated
Air lock	1	IP66 Rated				
Loading Room	2	IP66 Rated	1	IP66 Rated	1	IP66 Rated

<b>Unloading Room</b>	<b>2</b>	<b>IP66 Rated</b>	<b>1</b>	<b>IP66 Rated</b>	<b>1</b>	<b>IP66 Rated</b>
<b>1.8M Wide Corridor</b>	<b>2</b>	<b>IP66 Rated</b>				
<b>1.8M Wide Outer Corridor</b>	<b>6</b>	<b>Modular</b>		<b>Modular</b>		<b>Modular</b>
<b>Staff Room</b>	<b>12</b>	<b>Modular</b>	<b>6</b>	<b>Modular</b>	<b>6</b>	<b>Modular</b>
<b>Rest Room Male</b>	<b>2</b>	<b>Modular</b>				
<b>Rest Room Female</b>	<b>2</b>	<b>Modular</b>				
<b>Storage / Service</b>	<b>4</b>	<b>Modular</b>	<b>1</b>		<b>1</b>	

**NOTE : All power point wiring shall done in 4 sqmm Cu wire**

Note : The quantities given above are tentative requirements and may be subject to minor changes during final designs. The final quantity shall be as per approved designs and drawings by HITES and the same be provided by the contractor, at no extra cost.

## **E. HVAC WORKS**

### **1. GENERAL**

- i. The EPC Contractor shall carry out Design, Engineering, Supply, Installation, Testing& Commissioning of HVAC Works.
- ii. The entire HVAC works should conform to specifications provided & as per directions of Engineer-in-Charge. The ratings and capacities of various equipment's are indicative and subject to upgradation/ revision during detailed designing stage.
- iii. The scope shall include below mentioned features but not limited to:-
  - a. The design shall be done in accordance with Norms established by for HVAC System design, provisions stated in NBC 2016, latest ECBC and conforming to the latest ISHRAE, ASHRAE and technical specifications.
  - b. Objective of HVAC System Design is to ensure proper Pressure zoning Indoor Air Quality, Energy Efficiency, Flexibility of Operation, Cost Optimization, BMS Compatibility and Rating Compliances.
  - c. Heat Load is to be computed for individual rooms of required buildings which are to be air conditioned. All required parameters /factors like geographical location, orientation of building, ambient conditions, glazing factor, lighting/equipment load, occupant load, area & height of room, fresh air ACPH, CFM/person, ADP of coil, shall be considered as per ASHRAE/ISHRAE/NBC 2016/ECBC standards.
  - d. Equipment sizing of HVAC system shall take into account factors such as geographical location, climatic conditions, water availability & quality etc.
  - e. Suitable size shafts, cutouts, Niche, openings etc. shall be provided to facilitate installation of Pipelines, Ducts etc. in all floor slabs for various service areas, as required. All shafts, cutouts, Niche, openings etc. provided on floor slabs shall be suitably closed after laying of services lines as per fire safety norms as per NBC 2016. Doors shall be provided for all shafts at all floors as per fire safety norms as per NBC 2016.

- f. All Services as required like raw/ soft/, drainage, plumbing, HVAC provisions, ducting etc. shall be adequately provided by the EPC .

**2. Design Standards :**

- The following design standard shall be followed in HVAC: -
- National Building Code 2016
- CPWD HVAC Specification 2017
- ASHRAE Standard 170-2017-Health Care Facilities
- ASHRAE 62.1-2010– Indoor Air Quality
- 
- ASHRAE 52.2-2007 – Filter Selection & Efficiency
- ASHRAE Handbooks
- ASHRAE 90.1-2010 – Energy Standards for Building
- SMACNA – For Air Distribution
- Latest BIS codes for Motors, Cabling, Wiring and accessories
- National Electric Codes (NEC) latest version
- Biosafety Guidelines (BMBL, WHO, DBT & ICMR Guidelines)

**3. Air Conditions & Ventilation System Schedule:**

Ground Floor		SYSTEM	ACPH	PRE – FILTER	FINE FILTER	HEPA FILTER SUPPLY	HEPA FILTER EXHAUST
	System G-1	FCU	-	√	χ	χ	χ
	System G-2	Only Ventilation Exhaust	3-5	χ	χ	χ	χ
	System G-3	100% FA System	Min 12	√	√	√	χ
	System G-4	100% FA System	Min 12	√	√	√	√
	Office	FCU	-	χ	χ	χ	χ
	Staff Room	FCU	-	χ	χ	χ	χ
	Rest Room Male	Ventilation Fan	-	χ	χ	χ	χ
	Rest Room Female	Ventilation Fan	-	χ	χ	χ	χ
	DA Toilet	Ventilation Fan	-	χ	χ	χ	χ
	MGPS Room	Ventilation Fan	-	χ	χ	χ	χ
	UPS Room	FCU	-	χ	χ	χ	χ
	Electrical Room	Ventilation Fan	-	χ	χ	χ	χ

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First Floor		SYSTEM	ACPH	PRE – FILTER	FINE FILTER	HEPA FILTER SUPPLY	HEPA FILTER EXHAUST
	System F-1	100% FA System	Min 12	√	√	√	√
	System F-2	100% FA System	Min 12	√	√	√	√
	System F-3	recirculatory	3-5	√	χ	χ	χ
	System F-4	Recirculatory 70% 30% Exhaust	6	√	√	χ	χ
	Staff Room	FCU	-	χ	χ	χ	χ
	Rest Room Male	Ventilation Fan	-	χ	χ	χ	χ
	Rest Room Female	Ventilation Fan	-	χ	χ	χ	χ
	Store	FCU	-	χ	χ	χ	χ
	Autoclaving	Ventilation Fan	-	χ	χ	χ	χ
	Lab In charge	FCU	-	χ	χ	χ	χ
	BMS Room	FCU	-	χ	χ	χ	χ

#### 4. HVAC System Design Principles:

- Objective of HVAC System Design is to ensure proper pressure gradient cascade, thermal comfort & Indoor Air Quality as per design standard mentioned above along with Energy Efficiency, Flexibility of Operation, Cost Optimization, BMS Compatibility.
- Pressure gradient in different zones and labs shall be maintained as provided in tender drawings.
- The BSL-3 containment exhaust shall be provided with backup/standby provision in N+1 configuration, where N is required nos. working and 1 is standby unit.
- One number standby (N+1 configuration) shall be considered for Chillers, all type of Pumps, etc. & also provision of space shall be kept for installing standby equipment.

- HVAC Plant Room shall be provided with safety equipment / items like suitable elastomeric mat (as per relevant IS codes) for Panels, fire buckets, fire extinguishers, hand gloves, safety charts, framed Schematic / SLD etc.
- Chilled water pipes from HVAC Plant Room to various AHU's in the building shall be laid as per CPWD specs.
- Suitable size shafts, cut-outs, Niche, openings etc. shall be provided to facilitate installation of Pipelines, Ducts etc. in all floor slabs of various buildings for various service areas, as required. All shafts, cut-outs, Niche, openings etc. provided on floor slabs shall be suitably closed after laying of services lines as per fire safety norms as per NBC 2016. Doors shall be provided for all shafts at all floors as per fire safety norms as per NBC 2016.
- EPC Contractor should design provisions to maintain humidity of the conditioned areas in all weather conditions.
- Air Handling Units shall be installed with sufficient service space all around.

## **5. Special Considerations for Critical Areas:**

- Inner laboratory temperature should be maintained at  $22 \pm 2$  °C.
- Air changes per hour shall be as provided in HVAC system schedule.
- RH shall be maintained at 55%. Active humidity control is to be instituted in all rooms.
- Appropriate devices to monitor and display these conditions shall be installed.
- Exhaust Fan location for BSL-3: Minimum 25 ft from AHU intake.
- Air velocity at exhaust discharge: 15-20 m/s (3000-4000 fpm) for BSL-3.
- Pressure gradient to be maintained in the various rooms as provided in tender drawings.
- Ventilation Design and Air Filtration to dilute and remove contamination in the form of odour, airborne microorganisms.
- Magnehelic Gauges/ Electronic Pressure Gauges to be installed in all areas inside labs for measuring differential pressure between zones.

## **6. Air Conditioning System:**

- Centralized Inverter scroll type air cooled Chilled Water Air Conditioning System being considered for the facility.
- Provision of energy efficient split units shall be considered. Energy Efficient Air Conditioners with Inverter driven compressors (min. 5 star rated) may be considered wherever necessary depending upon the suitability and applicability.
- All the equipment's etc. shall be suitable for 415 V, three phases or 220 V, Single phase, 50 Hz A.C. supply.
- The chilling machines shall be AHRI/ Eurovent certified with eco-friendly refrigerant and with best possible COPs as per latest ECBC code, Fans shall be



AMCA certified for fan efficiency & Noise, Fire dampers shall be UL555 certified.

- Provision of specialized equipment like Vacuum Degasser/Air and Dirt Separator/Dirt Separator /Descalar in the Plant Room to ensure smoother operation, enhanced efficiency of system and longevity.
- u-PVC Pipe for drain with suitable insulation for chilled water system
- Ceiling Suspended and Floor Mounted Air Handling Units, chilled water Fan Coil Units to Convey Chilled Air in case of Chilled Water System
- Fresh air provision for FCU Indoor Units shall be considered as per relevant codes & standards. Double Skin (25 mm thick casing with inner and outer sheet shall be of GI thickness 0.63) FFU (Fan Filter Units with MERV-8) shall be used to supply fresh air for the areas which are fed through FCU.
- Pressurized Expansion Tank to adjust and regulate the pressure of water in the Chilled Water Circuit shall be provided
- Ducting System comprising of SS 304 ducting (in BSL-3 Lab) & GI Ducting in other areas with Insulation/Pre-Insulated Ducting depending upon the requirement.. Duct Construction and suspension Standards must conform to CPWD/SMACNA, IS 655 and ASME.
- Chilled Water flow Modulation by means of Manual/Motorized Butterfly, Non Return Valve, Ball Valve, Automatic Balancing Valve, 2 WAY PIBCV with insulation. All the valves must be minimum PN16 rated and suitable for Chilled Water applications. Insulation of valves shall be the same as that of pipe
- Chiller plant Manager shall be provided in the plant room
- Air Flow Modulation by means of Air Distribution devices like Volume Control Duct Dampers, Collar Dampers, CAV/VAV Boxes conforming to ASME and SMACNA Standards.
- The scheme of colour code painting of pipe work services for AC installation shall be as per NBC/CPWD specifications.
- Provision of trap door of suitable material & size shall be considered for easy accessibility of moving parts of the concerned equipment/dampers.
- BMS Compatibility to all Air Conditioning (3 phase equipment) High Side and Low Side Equipment.

## **6. Mechanical Ventilation:**

- For Mechanical Ventilation designing, NBC 2016 (National Building Code of India) guidelines shall be followed.
- Box type acoustically insulated Inline fan shall be used for toilet ventilation of larger toilet area. For smaller toilet / toilet on external facade / toilet with single WC / private toilet, Propeller fan shall be used.
- Latest NBC norms prevailing at the time of approval & execution to be followed.

S. No.	Description	Fan type
1	Toilet (Public)	6 to 10 ACPH
2	Stores	6 ACPH
3	AC Plant/Other Plant Rooms/LT/HT Panel Room/MGPS	12 ACPH
4	Laboratories and critical area	As provided in HVAC system schedule
5	Bio Medical Waste	25 ACPH

**Note:** Separate exhaust duct shall be provided for toilets, pantries, Laboratories, dirty utility areas etc. These shall not be combined with each other or with any other exhaust ducts of AC System.

S. No.	Description	Fan type
1.	Toilet Exhaust	Centrifugal Inline/Propeller as per requirement
2.	PlantRoom/Pump Room/lab/inside building STP/ ETP etc.	Double Skin Cabinet Type Blower (SISW/DIDW meeting functional requirement)

Three phase fans shall be with IE-3 motors & Toilet Exhaust shall be with min. IE2 rated motors.

## 6. Plant Room Layout:

- The plant room equipment shall conform to CPWD norms & other relevant codes so as to have proper distance between chillers/pumps/other equipment.
- The HVAC Plant Layout must be planned in such a manner so that it enables easy movement of personnel to conduct daily routine and maintenance procedures. Additional space for circulation shall be considered as per relevant codes. Provision shall also be kept for anticipated future requirements.
- Proper spacing must be ensured between the foundations of Pumps, Chillers and other equipment to enable repairs and easy replacement of parts.
- The Plant Room must be adequately ventilated with Fans maintaining optimum Air Flow and ACPH level. The design and sizing of Fan must be in conformity with the CPWD & NBC norms for the same.

- Sufficient Floor loading shall be considered for HVAC Plant Room. The Plant Room should have a fresh water connection & drain trap.
- The floor shall have suitable drain facilities.
- Adequate level of illumination must be ensured to enable smooth maintenance and repair procedures.

## 7. HVAC Shaft:

- Sufficient number of shafts shall be provided so that piping length is optimized.
- The HVAC Shaft must be adequately sized to enable smooth passage of pipes & ducts with insulation along with its supporting arrangement through it and also for easy movement of personnel for maintenance
- The walls of the HVAC Shaft must be lined with Fire Rated Material capable of withstanding 250 degree Celsius for a period of 2 hours.

## 8. AHU Rooms :-

- AHU Room slab shall be structurally designed to take loads of various equipment.
- The AHU Room Layout must be planned in such a manner so that it allows easy movement of personnel to conduct daily routine and maintenance procedures.
- AHU foundation shall be proper (PCC/RCC/Steel frame) in conformance to relevant standards. All measures shall be taken including providing vibration isolation pads etc. should be used to dampen noise generated at source itself.
- AHU Room shall be acoustically insulated with suitable eco-friendly material (density, K value) as per CPWD provisions & site requirements.
- Suitable Floor loading shall be considered for AHU Room.
- AHU Room should have a fresh air opening, water connection & drain trap.
- Arrangement for adequate Natural Ventilation must be made in the AHU Rooms

## 9. Basis of Design

The HVAC system shall be designed to cater air conditioning requirement to the different areas of the building to maintain following conditions.

- Inside Temperature : 22 +/- 2° C
- Relative humidity : less than 60%

Site location. : **Thonnakkal, Thiruvananthapuram (KERALA)**

The Air conditioning System shall be designed on the out door conditions of Summer, Monsoon and Winter conditions of the locations.

- Inside Conditions. As per ISHRAE & other Biosafety standard.

- Lighting Load: As per ECBC
- Equipment Load: As per Actual
- Acceptable Indoor Noise Levels: As per ASHRAE & DBT standard.
- Fibrous acoustic insulating material shall not be used. Supply air ducts shall be externally insulated as required.

#### **10. Building Construction Data:**

The building shall be designed as RCC framed structure.

- All U value, SHGC, VLT etc of Glazing, Roof/Wall Insulation etc. shall conform to ECBC norms.
- Exhaust outlets shall be located at a minimum height of 3 m away from ground level and away from doors, occupied areas and operable windows.

#### **11. Estimated Refrigeration Load**

The estimated tentative cooling load for the BSL-3 Laboratory Building is 120 TR. It is proposed to provide 3 Nos. 60 TR capacity Chillers (2 Working + 1 Standby). This will be the minimum capacity to be provided by the contractor.

A detailed heat load estimation sheet shall be prepared by the EPC Contractor during detailed engineering stage for all the seasons (Summer/Monsoon/Winter) in which, the specified conditions are to be maintained based on the given design and other performance requirement parameters. If the Final Approved heat load calculations is more than 120 TR, the chillers of actual required capacity shall be provided by the EPC Contractor without any additional financial implications.

### **G. ELEVATOR/LIFT WORK**

#### **GENERAL:**

- The EPC Contractor shall carry out Design, Engineering, Supply, Installation, and Testing & Commissioning of Machine Room less Type Elevator/Lift Works.. The installation shall be carried out as per rules & regulation of local bodies and IS Codes that governs the requirement of installation of the lift. The voltage and frequency of the supply shall subject to variation permissible under Indian Electricity Act and Rules.

#### **NOTE:**

1. Lift Well, Car Size, Lift Pit Depth, Overhead, and Clear Entrance Width & Height dimensions shall conform to NBC 2016 or OEM Standards/ recommendations. All lifts shall be Gearless Type without Machine room & Centre Opening.
2. Passenger Lift Speed: All building 0.75 TO 1.00 mtr/sec.

3. Car enclosure & doors shall be made out of SS 304 sheet of required thickness.
4. All lift shall have necessary provisions & door opening as required for physically challenged person.

**APPLICABLE CODE AND STANDARDS:**

- I. NATIONAL BUILDING CODE 2016.
  - II. INDIAN ELECTRICITY ACT AND RULES.
  - III. IS CODE 14665 – 1/2/3/4/5 ETC.,
- 
- A1 Elevator equipment shall be furnished and installed in accordance with either ASME A17.1 or EN 81 including the latest supplement. No degradation of ASME / EN 81-1 requirements is acceptable simply on the basis of the local code requirement. It is acceptable only when the ASME A17.1 / EN 81 is in direct conflict with local code requirements and where the latter is more stringent than the former. In any case the completed equipment shall more than fully comply with applicable and prevalent IS codes and Local Lift Acts and / or Rules.
  - A2 The equipment and the work shall be in line with the best available International standards of Engineering, Design and Workmanship for the particular category of equipment. All materials, tools and tackles incorporated in the Works shall be suitable for the duty concerned and shall be new and of best commercial quality, free from imperfections, and selected for long life and minimum maintenance under the local and installation site conditions.
  - A3 **POWER SUPPLY CONDITIONS:** The Contractor shall verify the power supply and assess the quality of power. Any voltage stabilizer / UPS required shall be provided by the Contractor.
  - A4 **MODIFICATIONS TO STRUCTURE:** Modification of already constructed structures by cutting, chipping or welding shall not be permissible without written approval from a qualified and practicing engineer in charge. Such modifications shall be done only after the contractor has exhausted all other remedies. All costs of such modification and consequence shall be debited to the party responsible for the lapse.
  - A5 **LAYOUT DRAWINGS:** The drawings on a minimum shall provide the following data: a) Owner's requirements b) Maximum bracket spacing, c) Forces acting on the guide rails on application of the safety or other retarding device, d) All forces on the building structure including the machine room e) static and impact loads imposed on machinery, sheave beams, supports, floors or foundations, f) Impact loads on buffer supports and the pit, g) All electrical requirements stating the current ratings. Three copies of as-built drawing shall be submitted at the time of handover of the units.
  - A6 **MATERIALS:** All materials incorporated in the Works shall be suitable for the duty concerned and shall be new and of best commercial quality, free from imperfections, and selected for long life and minimum maintenance under the local and installation site conditions.

- A7 **AESTHETICS:** All aesthetic requirements including and not restricted to claddings, false ceilings, floorings, color, fixtures, lighting arrangements, grills etc. shall have to be approved in writing by the Employer. All equipment visible from the lobbies, corridors shall be aesthetically integrated with the surrounding finishes to the Employer's satisfaction. All signage / notices shall be aesthetically acceptable to the Employer.

**B BRIEF TECHNICAL SPECIFICATIONS OF ELEVATOR**

<b>ELEVATOR TYPE</b>	Passenger Lift
<b>USAGE OF ELEVATOR</b>	Visitors
<b>TYPE</b>	MRL
<b>QUANTITY</b>	1 Nos
<b>CAPACITY</b>	Min 6 Passenger
<b>SPEED(METERS/SEC )</b>	MAX 1.00
<b>CONTROL</b>	AC-VVVF
<b>APPROXIMATE TRAVEL (METERS)</b>	AS PER APPROVED DRAWING
<b>STOP</b>	3 STOP 3 OPENING
<b>CABIN ENTRANCE DOOR OPENING ARRANGEMENT</b>	CENTER/SIDE
<b>CLEAR CABIN ENTRANCE SIZE</b>	800 X 2000
<b>CAR SILLS &amp; LANDING SILLS</b>	EXTRUDED HARD ALUMINIUM
<b>CAR OPERATING PANEL TYPE</b>	AS PER CODE/APPROVED BY CLIENT
<b>POWER SUPPLY FOR TRACTION MACHINE</b>	415 V 3 PHASE 50 Hz WITH VOLTAGE VARIATION OF + 5 ~ - 10 %
<b>POWER SUPPLY FOR CABIN LIGHTING</b>	415 V 3 PHASE 50 Hz WITH VOLTAGE VARIATION OF + 5 ~ - 10 %

## **H. FIRE FIGHTING SYSTEM**

### **GENERAL**

The EPC Contractor shall carry out Design, Engineering, Supply, Installation, Testing & Commissioning for conventional Fire Fighting Works. Every Building Safety point of view fire system recognized that fire safety plays an important role in influencing building design. The development of fire safety objectives at an early stage of the design process, and progressing throughout the project phases is to ensure the continuity of cohesion of fire safety design.

Fire Fighting system shall comprise of Down comer System, Fire Extinguishers, Fire Signage's, Fire Brigade Inlet/Draw Out Connections etc. proposed. Suitable size shafts, cutouts, Niche, openings etc. shall be provided to facilitate installation of Pipelines etc. in all floor slabs for various service areas, as required. All shafts, cutouts, Niche, openings etc. provided on floor slabs shall be suitably closed after laying of services lines as per fire safety norms as per NBC 2016. Doors shall be provided for all shafts at all floors as per fire safety norms as per NBC 2016.

The ratings and capacities of various equipment are based on NBC 2016 Part - IV and subject to revision during detailed designing stage. The firefighting system is proposed on basis of type of occupancy as per NBC 2016 Part -IV and building Height. The system proposed are water based. However specialized areas such as server rooms etc shall be provided with Gas suppression system. Water based Fire suppression system is having piping network inside and outside the building with internal and external Hydrants, First Aid Hose reel at regular intervals according to various type of occupancy. The distribution system is finally connected to ring main system for firefighting.

The contractor shall study the existing Fire Hydrant System in IAV and shall plan and design to extend the existing Fire Fighting installation for providing and inclusion in BSL-3 Laboratory building. The proposed system shall include all materials, equipment & installation as required, as per statutory requirements complete as required. The contractor shall be responsible for obtaining approval and clearance of Fire Fighting system scheme designs and drawings from Fire Authorities.

### **STANDARDS & CODES**

The following standards, bye-law, manual has been followed in designing the firefighting system:

- a) National Building code Part IV for fire Protection System 2016.
- b) Pumps, Valves and Accessories shall be preferably UL listed and FM approved.
- c) CPWD General Specifications for Electrical Works-part V (Wet Riser & Sprinkler System-2006).
- d) NFPA/UL/FM certifications & TAC for guidance.
- e) Relevant IS codes published by Bureau of Indian Standards.

Specifications for GI / MS Pipes	:	IS-1239 / IS3589
Specifications for Gun metal gate, globe valve	:	API 600 / BS 5163
Check valves for water supply	:	IS778/780/2906
Specification for covered electrodes for metal are welding for structural steel	:	IS-880
Specifications for CI Butterfly valve	:	BS-5155
Specifications for canvas hose pipes	:	IS-4927
Specifications for branch pipes fire hose coupling and auxiliary equipment's	:	IS-903
Specifications for hydrant landing valves	:	IS-5290
Method of measuring of building & civil Engineering works (Water supply, plumbing drain & sanitary fittings)	:	IS-1200
Recommended practice for radio graphic Inspection of fusion welded butt joints in steel Pipes	:	IS-4853
Synthetic, jacketed hose pipes	:	IS-636
Specification for painting	:	IS-5
Specification for horizontal end suction Centrifugal pump	:	IS-9137
Specifications for Butt welded pipe fittings	:	BS-1965 part 1
Controlled percolating hose for fire fighting	:	IS-8423
Branch pipe, universal for firefighting purposes	:	IS-2871
First aid hose reel for fire fighting	:	IS-884
Code of practice for selection, installation and Maintenance of portable first aid fire extinguisher	:	IS-2190
Specification for washers for water fittings for firefighting Systems	:	IS-937
Specification for automatic sprinkler heads	:	IS-9972
Dry chemical powder type fire extinguisher	:	IS-2171
Water type CO2 fire extinguisher	:	IS-940
Carbon-di-oxide type fire extinguisher	:	IS-2878
Copper wire	:	IS-694
PVC Insulated Braided wire	:	IS-9968



PVC Insulated cables	:	IS-1554
Paint shade for main equipment's/accessories	:	Shade No.536 of IS-5
Fire Safety of Building (Electrical Installation)	:	IS 1646

**CLASSIFICATION AND CODE OF FIREFIGHTING SYSTEM (BASED ON NBC):**

Classification of Hazard : Business building  
Group : 'E'  
Category : 1) Less than 10 m in height

**DESIGN PARAMETERS:**

The fire safety provisions incorporated into the design are in accordance with the National Building Code Regulations Requirements and above said standards. Any modifications that have been made to the property have continued to have these standards implemented as an integral part of the design specification requirements and statutory approval. The fire safety of the complex is based on Fire Engineering principles and due to the size of the building some are unique to this facility.

**WATER REQUIREMENTS:**

Water services for Hydrants system shall be stored in overhead tanks.

**a) OVERHEAD STORAGE FIRE TANK:**

Overhead fire water tanks on the terrace will be provided for wet riser system and as supplementary fire storage as per NBC requirement/ Bye laws. The effective capacity of reservoir, as per Table 7 of NBC 2016 Part – 4, is given below:-

SL. NO.	OVERHEAD TANKS	CAPACITY OF RESERVOIR
1.	Terrace Tank	10000 Litre / Capacity as per NBC 2016 - Part IV -Table -7

**3.SYSTEM DESCRIPTION:**

The Fire Fighting System shall consist of Down comer system with terrace pump, Pressure vessel, associated instruments, cabling, piping (internal & external), valves, Fire Brigade inlet connections for wet riser, fire signage's, extinguishers, Gas based fire suppression system, Fire detectors, Discharge Nozzles, control panel etc. has to be provided as per NBC 2016 requirements. Terrace pump shall maintain pressure in all water lines for fully charged under pressure for full Automatic operation in case of fire.

**a) FIRE HOSE CABINET - SHAFTS & ROOM PROVISIONS:**

FHC - Minimum size of shafts to be provided to accommodate down comer /drain pipes etc. will be 2100 X 900 MM (approx.) or as per CPWD standards and to be provided at suitable locations as per relevant codes & standards. At places where this size is not

feasible, shaft size as per site conditions meeting functional requirement may be accepted as per directions of E-I-C.

- Shafts & Inspection doors shall be minimum of 120 minutes fire rated or as desired by relevant codes.

**b) EGRESS COMPONENTS:**

Egress components to be considered are the no. of exits to which access is provided, capacity of exit access, travel distance to an exit, directional exit etc.

- The width of corridors, aisles/ramps required for exit access shall be sufficient to ensure smooth flow of occupants to exit. Exits shall be so located that the travel distance on the floor shall not exceed distance as mentioned in NBC 2016.
- No exit doorway shall be less than 1000 mm in width. All exit doorways shall not be less than 2000 mm in height.
- The requirements of nos. of staircases shall supplement the requirements of different occupancies as per NBC 2016 norms.

**PUMPS & RELATED EQUIPMENT/PIPING & RELATED ACCESSORIES:**

- Quantity & Type of Fire Pumps (Terrace Booster) shall conform to NBC 2016/relevant IS codes.
- All fire pumps shall be with positive suction arrangements.
- Capacity of the Pumps shall be selected as per latest NBC 2016 /NFPA/IS codes & Head as per Building Height & Frictional losses due to bends, pipe lengths etc.
- Horizontally mounted end suction/split case single stage, single outlet energy efficient centrifugal pump, suitable for operation on 415 volts  $\pm$  10%, 3 phase, 50 HZ A.C supply, IE-2 Class efficiency motor, complete with flexible coupling (double arch) and coupling guard as required. Fire pump having C.I. body, bronze/gunmetal impeller and S.S. Shaft with mechanical seal to be considered. Casing shall be designed to withstand 1.5 times the working pressure.
- All the fire pumps shall cut-in automatically based on the pressure settings in pressure switch, so as to ensure that the entire fire main line, risers etc. are pressurized on a continuous basis.
- The terrace pump shall automatically cut-out based on the pressure settings of pressure switch.
- All Foundation (PCC/RCC) for Equipment including foundation bolts & vibration isolation springs/pads shall be provided.
- MS (Class C) pipes conforming to IS: 1239/3589 including all fittings like bends, elbows, tees, anchor fasteners, couplings etc. shall be used in firefighting system.
- Suspenders, Brackets & Floor/Wall supports for suspending / supporting pipes to be provided.
- Pressure gauge needs to be provided at each landing/ floor of the building for wet riser/down comer system.
- Till 50 mm dia. Pipe, screwed joints shall be provided & 65 mm dia. & above, welded joints shall be provided. (Recommended to go for MS "C" class pipe)
- Suction dia. & discharge dia. of pumps shall be as per pump discharge as per OEM standards.
- The entire pipe work (above ground), pump etc. shall be painted with one coat of primer & two or more coat of red color shade no. 536 of IS: 5 (Post Office synthetic enameled red paint) as per directions of Engineer-in-Charge.
- At terrace/Remote level hydrant, minimum 3.5 kg/sq.cm. Pressure shall be maintained.

- The pipeline shall be designed with suitable flow velocity & friction factor as per relevant standards.
- All pipes below ground will be protected against soil corrosion by wrapping & coating material as per IS: 10221.
- Pipes of 150 mm dia. & below, will conform to IS: 1239. Pipes of 200 mm dia. & above will conform to IS: 3589. MS “C” class pipe.
- Suitable Nos. of Installation control Valve (ICVs) to be considered conforming to latest IS codes depending upon no. of sprinklers.
- All necessary valves of PN 16 rating (min.) like butterfly/ globe/ gate/ non return/ sluice, Y/Pot Strainers, pressure gauges etc. to be considered as per requirement (controlling flow/ isolating/one way flow etc.) & meeting the functionality.
- Pressure vessels shall be provided at plant room also.
- All Pumps shall be provided with flexible bellows (double arch, PN-16 Rating) to dampen vibration/noise at source.
- Vibration Isolators/Anti Vibration Pads needs to be provided for all pumps to absorb vibration at source.
- Orifice Plate shall be considered to reduce pressure on individual hydrant to maintain operating pressure of 3.5 kg/sq.cm.
- Air vessel/Pressure vessel of suitable size need to be provided near terrace pump. To compensate for slight losses of pressure in the system and to provide an air cushion for counteracting pressure surges / water hammer in the pipe work air vessel conforming to IS: 3844 shall be furnished in the pump room near pump. The air vessel shall normally be half full with water and remaining filled with air which shall be under compression when the system is in normal operation.
- Pump/ Motor placed on Terrace /open area should be weather proof type & required size of canopy also needs to be provided.
- All pipes should be placed at fixed support. Pedestals at suitable distance to be provided as per requirements & directions of E-I-C.

**c) NO. OF PUMPS WITH CAPACITIES PROPOSED IN FIRE PUMP ROOM:**

SL. NO	FIRE PUMP ROOM EQUIPMENT PROPOSED TO BE PROVIDED
1.	450 LPM / 10000 Litre / Capacity as per NBC 2016 - Part IV -Table -7 – 1 nos. Terrace Pump. unless otherwise stated.

The above mentioned capacities are indicative only. The EPC contractor has to execute the work with suitable capacities as per latest standards and codes.

**WET RISER& HYDRANTS SYSTEM:**

**INTERNAL HYDRANTS:**

- It shall consists of Type -A- single headed or Type B double Headed (as per requirements), SS ISI marked oblique pattern hydrant landing valve with 80 mm dia. flange inlet and 63 mm dia. instantaneous type female out let, swinging type First Aid hose reel in red color drum with 30 mtr long and 20/19 mm dia. heavy duty rubber water hose, 20 mm dia. Globe valve stop cock, terminating with G.M. coupling & nozzle of 5mm outlet with shut off valve, 63mm dia. SS branch pipe with gun metal

nozzle of 20 mm nominal bore outlet with instantaneous type 63 mm dia. coupling, fireman's axe with heavy duty insulated rubber handle, 2 Nos. of 15 m long Non Percolating Hose Pipe, suitable size of MS door made up of 16 gauge MS Sheet capable of accommodating fire hose reel, landing valve, hose pipes, fittings. The door shall have a front glass with lock and key arrangement & shall be painted with one coat of primer & two coat of finished stove enameled post office red color paint & "Internal Fire Hydrant" written on front.

- Quantity for the same need to conform to NBC 2016/relevant IS codes.
- One no. pressure gauge to be provided in each internal hydrant riser per floor.
- No. of risers/floor in each building shall be governed by the max. Travel distance as specified in NBC 2016.
- Adequate No. of FHC to be provided at Terrace for mitigating fire due to MEP Equipment placed at Terrace.

#### **FIRE BRIGADE INLET CONNECTIONS:**

- 4 Way Fire Brigade Inlet connection complete with all accessories (sluice valve/NRV etc.) shall be provided for connection to Ring mains, at delivery header in pump house, main hydrant line feeding to building, Partial Under/Over ground tank.
- All these above shall be in line with relevant IS codes & as per direction of E-I-C.

#### **PORTABLE FIRE EXTINGUISHERS:**

- The sufficient qty. of portable/trolley mounted type fire extinguishers (Gas Based stored pressure type CO2 type /Ammonium Phosphate Type/ Mechanical Foam etc.) shall be provided at all levels of the building, plant room, basement, substation etc. at strategic locations as per requirements, generally to follow NBC-2016 and IS – 2190: 1992 to extinguish fire of class A, B ,C.
- Location of the Fire Extinguishers shall be considered near all the Internal Hydrants, HT Panel Room, LT Panel Room, Lift Machine Room, Fire Pump House, Server Room, UPS Room, Fire Control Room, Security Control Room and WTP etc.
- Clean agent fire extinguishers needs to be provided in all Labs, UPS/Batteries Room, BMS Room, other LV Rooms & any other critical areas where it is required as per functional requirements & as per directions of E-I-C.
- All Fire Extinguishers shall be Halon Free.
- Sand buckets 1 set (2 Nos.) of 9 liter capacity for each DG Set/Transformer/ shall be provided. It shall also be in line with relevant norms & standards.
- Minimum provision of Fire Extinguishers as per IS 2190 to be provided in addition to provisions stated in DBR.

#### **FIRE SIGNAGE:**

Various types of signage are proposed in the complex as per NBC 2016 Part -4. Material of signage shall be of acrylic/aluminum of required dimensions. At every floor near Lift landing diagram showing stairways shall be provided mentioning instructions - 'IN CASE OF FIRE USE STAIRS UNLESS INSTRUCTED OTHERWISE'. The signage shall be above call push button in Lift Lobby. Floor Signage will be provided in each floor within the staircase & should easily readable. Each corridor of every floor will have directional signage indicating Fire Escape route. These Signage may be LED light with UPS power

backup or of photo Luminescent paint as per requirement & directions of E-I.C so that they will be visible in dark in case of power failure. Signage for Assembly Point also needs to be provided. Evacuation path signage & Emergency Exit signage shall also be provided. Some of the signage shall be hung from ceiling (both ways) to have proper visibility.

**ELECTRICAL WORK RELATED TO FIRE FIGHTING SYSTEM:**

- Firefighting panel of suitable size incomer & sufficient nos. of outgoing feeders for all pumps along with spares/spaces to be provided. Panel open should have protocol communication enabled on Modbus/RTU
- Power cabling of suitable size to be laid from LT panel to firefighting panel. Power cabling of suitable size from firefighting panel to fire pumps to be laid. Control cabling from fire pumps to firefighting panel & firefighting panel to pressure switch to be done.
- Suspenders and/or cable trays for laying cables to be used.
- Motor shall be TEFC squirrel cage AC induction type. The motor shall be suitable for continuous duty & rating necessary to drive the pump at 150% of its rated discharge with at least 65% rated head. Motor shall be with class F insulation & IE-2 class efficiency. DOL/star delta starter to be provided as per H.P rating of motors.
- Adequate no. of NO/NC contacts for interlocks, indicating lamps, remote operation etc. shall be provided on starter/contactors.
- Metallic body of all motors, medium voltage equipment etc. shall be connected by 2 separate & distinct earth conductors to the earth stations of the installations. Looping of such body earth conductors is acceptable from one equipment to another.