



**Tender No. CGM/DFCCIL/NOIDA UNIT/INTERIOR FITOUT WORKS/HHRI & CTP-14 OFFICE  
BUILDING /SEC-145/NOIDA/2021/05**

**For**

**Name of Work: Interior Fitout works such as False Ceiling, Partitioning, Wood work,  
Electrical, HVAC, IT, Furniture and other allied works for under construction DFCCIL  
HHRI Building complex and 2<sup>nd</sup> Floor of CTP-14 office at Sec-145, Noida.**

**E-TENDER DOCUMENT  
TECHNICAL BID  
(PACKET-A)**

**Employer:  
DEDICATED FREIGHT CORRIDOR CORPORATION OF INDIA LIMITED  
(A GOVERNMENT OF INDIA ENTERPRISE)  
Under  
MINISTRY OF RAILWAYS**

**NOIDA OFFICE: -**

Chief General Manager/Noida/DFCCIL  
D-89, 1<sup>st</sup> Floor, Sector-2, Noida- 201301

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## **PART-I**

### **CHAPTER-I**

# **CHECK LIST OF DOCUMENTS TO BE UPLOADED IN E-TENDER**

**PART-I**  
**CHAPTER-I**  
**CHECK LIST**

<b>Check List of items/documents pertaining to Bid to be uploaded by the bidder in E-Tender portal on or before the last Date &amp; Time of Bid Submission</b>	
<b>Item No.</b>	<b>Items</b>
<b>Technical Bid (Packet-A)</b>	
1	<p>EMD of <b>Rs. 9,72,900/-</b> (<i>Rupees Nine Lakh Seventy Two Thousand Nine Hundred Only</i>) to be paid online through payment gateway provided at <a href="http://www.ireps.gov.in">www.ireps.gov.in</a> in the account of Dedicated Freight Corridor Corporation of India Ltd., New Delhi on or before schedule date &amp; time of submission of bid.</p> <p><u>Note:</u></p> <p>(i) Any firm recognized by Department of Industrial Policy and Promotion (DIPP) as 'Startups' shall be exempted from payment of Earnest Money on submission of Registration Certificate issued by appropriate authority.</p> <p>(ii) 100% Govt. owned PSUs shall be exempt from payment of earnest money deposit.</p> <p>(iii) Labor Corporate Societies shall deposit only 50% of above earnest money deposit.</p>
2	<p>Cost of Bid Document of <b>Rs.11,800/-</b> (<i>Rupees Eleven Thousand Eight Hundred Only</i>) (Non-Refundable) to be paid online through payment gateway provided at <a href="http://www.ireps.gov.in">www.ireps.gov.in</a> in the account of Dedicated Freight Corridor Corporation of India Ltd., New Delhi on or before schedule date &amp; time of submission of bid.</p> <p>Note: "No exemption is admissible for cost of bid document and shall not be claimed by bidder on the E-Tender portal".</p>
3	A declaration from the person having PoA ( <i>Power of Attorney</i> ) on the Letter Head of the Applicant/Bidder that they agree and abide by the bid documents and amendments thereof ( <i>if any</i> ) and would execute the work accordingly. ( <b>Form No. 1A</b> )
4	Format for Certificate to be Submitted / Uploaded by Tenderer Alongwith the Tender Documents ( <b>Form No. 1B</b> )
5	Power of Attorney of the person authorized for signing/submitting the Tender ( <b>Form No. 22</b> ).
6	If applicable, the Power of Attorney for authorized signatory of JV partners and for Lead Member of JV ( <b>Form No. 12 &amp; 13 resp.</b> )
7	Documents in support of their formation as Proprietary Firm/ Partnership Firm/ Company/ Joint Venture/ LLP /Registered Society/ Registered Trust/ HUF as per the requirement defined in Para 1.3.16 of Part-I, Chapter-III of tender documents and Additional documents required in case of participation of Joint Venture and Partnership Firm as per the requirement defined in Para- 1.3.19 &

	1.3.20 of Part-I, Chapter-III (Preamble and General Instructions to Tenderers) of Tender Document.
8	Integrity Pact duly signed by the bidder ( <b>Form No.19</b> ). The bidders are required to download the Integrity Pact as uploaded on the tender document & sign the same put rubber stamp seal and upload the signed copy on E-Tendering website.
9	Submission of Tenderer's Credentials in accordance with Technical Eligibility Criteria defined in Para-1.3.14.1 (Preamble & General Instructions to Tenderer) of Part-I, Chapter-III of Tender Document in prescribed forms. ( <b>Form No.2A/2AA</b> )
10	Submission of Tenderer's Credentials in accordance with Financial Eligibility Criteria defined in Para-1.3.14.2 (Preamble & General Instructions to Tenderer) of Part-I, Chapter-III of Tender Document in prescribed forms. ( <b>Form No.2B</b> )
11	Applicants Party Information Form ( <b>Form No.2C</b> )
12	Memorandum of Understanding (in case of JV) as per bid document. ( <b>Form No.9</b> )
13	If applicable, Joint Venture agreement ( <b>Form No.10</b> )
14	Letter of participation from each partner of Joint Venture (JV)–( <b>Form No. 11</b> )
15	Valid GST Registration, EPF Registration and PAN No. details
16	No Deviation Certificate ( <b>Form No. 23</b> ).
17	The entire Tender document should first be downloaded & then, upload the same through digital signature by the Authorized signatory of the bidder.
18	All pages of all the Corrigendum/Addendum/Clarification ( <i>if any</i> ) should first be downloaded then, upload the same through digital signature by the Authorized signatory of the bidder.
<b>Financial Bid (Packet-B)</b>	
19	Financial Bid to be filled and submitted on <a href="http://www.ireps.gov.in">www.ireps.gov.in</a> by following the steps available at E-Tender IREPS Portal.

**Note:** All the uploaded documents should be in readable, printable & legible form.

### **IMPORTANT NOTES:**

- i. **Document mentioned at S.No. 1 to 16** above of the Check list [*Technical Bid (Packet-A)*] should be scanned and uploaded as attachment at E-Tender portal ([www.ireps.gov.in](http://www.ireps.gov.in)). The detailed instructions of E-tendering can be read through website [www.ireps.gov.in](http://www.ireps.gov.in) (*Learning Centre link provided on the home page*).
- ii. Similarly, the **document mentioned at S.No. 17 & 18** of the Check list [*Technical Bid (Packet-A)*] should first be downloaded from E-Tender Portal (*in PDF Format*) and thereafter upload them to E-Tender Portal, through digital signature.
- iii. **For Document No. 19** of the Check list [*Financial Bid (Packet-B)*], Financial Bid to be filled and submitted on [www.ireps.gov.in](http://www.ireps.gov.in) by following the steps available at E-

Tender IREPS Portal.

## **PART-I**

## **CHAPTER-II**

# **NOTICE INVITING E-TENDER**

## **PART – I**

### **Chapter II**

#### **DEDICATED FREIGHT CORRIDOR CORPORATION OF INDIA LIMITED (A GOVERNMENT OF INDIA ENTERPRISE)**

**Tender No: CGM/DFCCIL/NOIDA UNIT/INTERIOR FITOUT WORKS/HHRI & CTP-14 OFFICE BUILDING /SEC-145/NOIDA/2021/05**

#### **NOTICE INVITING E-TENDER National Competitive Bidding**

**Name of Work: Interior Fitout works such as False Ceiling, Partitioning, Wood work, Electrical, HVAC, IT, Furniture and other allied works for under construction DFCCIL HHRI Building complex and 2<sup>nd</sup> Floor of CTP-14-14 office at Sec-145, Noida.**

1.2.1 Chief General Manager/Noida, Dedicated Freight Corridor Corporation of India Limited, D-89, 1<sup>st</sup> Floor, Sector-2, Noida-201301, India, invites **E-Tenders** in **single stage two packet system** on prescribed forms from firms/Companies/Joint Ventures meeting requisite experience and financial capacity for execution of the following work:

Tender No.	<b>CGM/DFCCIL/NOIDA UNIT/INTERIOR FITOUT WORKS/HHRI &amp; CTP-14 OFFICE BUILDING /SEC-145/NOIDA/2021/05</b>
Name of Work	<b>Interior Fitout works such as False Ceiling, Partitioning, Wood work, Electrical, HVAC, IT, Furniture and other allied works for under construction DFCCIL HHRI Building complex and 2<sup>nd</sup> Floor of CTP-14 office at Sec-145, Noida.</b>
Employer/Client/Owner	Dedicated Freight Corridor Corporation of India Ltd. ( <i>DFCCIL</i> ), A Govt. of India ( <i>Ministry of Railways</i> ) Enterprises through Chief General Manager/Noida, D-89, 1 <sup>st</sup> Floor, Sector-2, Noida-201301.
Type of Tender	<b>Open E-Tender</b> ( <i>Single stage two packet system</i> )
Type of Contract	Works Contract
Total Estimated Cost	<b>Rs. 16,45,83,829/- (Rs. 13,94,77,821/- + GST @ 18%)</b>
Period of Contract	<b>09 Months</b>
Defect liability period	<b>12 Months</b> from the date of issue of completion certificate of the work by the DFCCIL



Earnest Money Deposit	<p><b>Rs. 9,72,900/-</b> (<i>Rupees Nine Lakh Seventy Two Thousand Nine Hundred Only</i>) to be paid online through payment gateway provided at <a href="http://www.ireps.gov.in">www.ireps.gov.in</a> in the account of Dedicated Freight Corridor Corporation of India Ltd., New Delhi.</p> <p><u>Note:</u></p> <p>(i) Any firm recognized by Department of Industrial Policy and Promotion (DIPP) as 'Startups' shall be exempted from payment of Earnest Money on submission of Registration Certificate issued by appropriate authority.</p> <p>(ii) 100% Govt. owned PSUs shall be exempt from payment of earnest money deposit.</p> <p>(iii) Labor Corporate Societies shall deposit only 50% of above earnest money deposit.</p>
Cost of Tender Document ( <i>Non-Refundable</i> )	<p><b>Rs 11,800/-</b> (Rs. 10,000/-+GST @ 18%) (Rs. Eleven Thousand Eight Hundred only) to be paid online through payment gateway provided at <a href="http://www.ireps.gov.in">www.ireps.gov.in</a> in the account of Dedicated Freight Corridor Corporation of India Ltd., New Delhi.</p> <p>Note: "No exemption is admissible for cost of bid document and shall not be claimed by bidder on the E-Tender portal".</p>
Validity of Offer	120 days
Retention Money	5% of Contract value ( <i>as per Clause No. 16 (1) of GCC</i> )
Performance Bank Guarantee	Performance Guarantee (PG) has to be submitted within 21(Twenty-One) days from the date of issue of Letter of Acceptance (LOA), amounting to 3% of the contract value.
E-tendering website	<p><b><a href="http://www.ireps.gov.in">www.ireps.gov.in</a></b></p> <p>For any help, please refer ""Learnig centre under E-Tender: Works , 1. "Instructions to Contractors"" containing the detailed guidelines for E-Tendering available on <a href="http://www.ireps.gov.in">www.ireps.gov.in</a> and on Helpdesk of IREPS: 011-23761525.</p>
<b>Date &amp; Time Schedule</b>	
Date of uploading of NIT/ Tender Document ( <i>Online</i> )	<b>On 15.11.2021</b>
Date of tender document download/Sale ( <i>Online</i> )	<b>From 11:00 Hrs of 16.11.2021</b>
<b>Pre-Bid</b> meeting with the prospective bidders	<b>-----</b>
Issue of Corrigendum, if any	<b>On or before fifteen days from date of submission of Tender (<i>on <a href="http://www.ireps.gov.in">www.ireps.gov.in</a></i>)</b>
Date & Time of Submission of Tender	<b>On or before 14.12.2021 and time upto 15:00 hrs</b>
Last date & time of submission of EMD & tender document cost	<b>On or before 14.12.2021 and time upto 15:00 hrs to be paid online through payment gateway provided at <a href="http://www.ireps.gov.in">www.ireps.gov.in</a></b>
Date & Time of Opening of Technical Bid ( <i>Online</i> )	<b>On date 14.12.2021 and time upto 15:30 hrs</b>
Date & Time of opening of Financial Bid ( <i>online</i> )	<b>To be communicated later</b> to only those bidders who are found technically qualified after closure of Technical Evaluation.

Representative/Contact Person of DFCCIL/Noida Unit	Shri Madhup Kumar Upadhyay Dy. Project Manager/Civil-I Dedicated Freight Corridor Corporation of India Ltd. (Noida Unit) D-89, 1 <sup>st</sup> Floor, Sector-2, Noida- 201301 Mobile No: 8826818484 Telephone: 0120-2542889 E-MAIL ID: <a href="mailto:mkupadhyay@dfcc.co.in">mkupadhyay@dfcc.co.in</a>
Address for Pre-Bid meeting & opening of Tender	Chief General Manager Office Dedicated Freight Corridor Corporation of India Ltd. (Noida Unit) D-89, 1 <sup>st</sup> Floor, Sector-2, Noida- 201301 Mobile No: 8826818484 Telephone: 0120-2542889

- 1.2.2 Eligibility shall be assessed on applicants, fulfilling the technical capability and competence as well as for financial and organizational resources as specified in **Clause no. 1.3.14** of Preamble and General Instruction to tenderers (*Part -I, Chapter-III of Tender Document*).
- 1.2.3 Tender document can be viewed & obtained/downloaded from [www.ireps.gov.in](http://www.ireps.gov.in) w.e.f. **11:00 Hrs of 16.11.2021**. The tender document shall have to be purchased in the name of Firms/Company/Joint Venture and can be downloaded from website [www.ireps.gov.in](http://www.ireps.gov.in). In case tenderer(s) do/does not deposit the cost of tender document (non-refundable) along with the submission of the tender, their tender shall not be opened. Tenderer are advised not to make any correction/addition/alteration in the downloaded tender documents. If any such correction/addition/alteration in downloaded tender documents are made such tenders shall be not be considered.
- 1.2.4 DFCCIL may issue addendum(s) / corrigendum(s) to the tender documents. In such cases the addendum(s) / corrigendum(s) shall be issued and placed on [www.ireps.gov.in](http://www.ireps.gov.in) only at least three days in advance of date of opening of tender. The tenderers who have purchased or downloaded the tender documents from the website before issue of addendum(s)/corrigendum(s) must visit the website and ensure that such addendum(s) / corrigendum (s) (if any) is also downloaded by them. Such addendum(s)/corrigendum (s) (if any) shall also be submitted/uploaded duly stamped and signed along with the submission of tender. Any tender submitted without addendum(s) / corrigendum(s) (*if any*) is **liable to be rejected**.
- 1.2.5 The tender documents shall be submitted in online mode only through website [www.ireps.gov.in](http://www.ireps.gov.in) in two packets only viz Packet-A containing TECHNICAL BID and Packet B containing FINANACIAL BID.

Bidder shall submit the **EMD & Tender document cost** (*as mentioned in clause 1.3.8.2 & 1.3.8.1 of preamble & general instructions to tenderer, Part I, Chapter III of Tender Document*) on or before schedule date & time of submission of bid.

**Financial Bid** (*as specified in "Financial Bid" in Tender Document*) to be filled and submitted on E-Tender portal [www.ireps.gov.in](http://www.ireps.gov.in) by following the steps available at E-Tender IREPS Portal.

It is mandatory for all Tenderers to have Class-III Digital Signature (or as specified in IREPS Portal) Certified from any of the Licensed Certifying Agencies ('CA') to participate in E-Tendering of DFCCIL, (Tenderer can see the list of Licensed CAs from the link [www.cca.gov.in](http://www.cca.gov.in) in the name of the person who will submit the Online tender and is authorized to do so.

- 1.2.6 To participate in the E-Tender, it is mandatory for the bidders to get themselves registered with the IREPS ([www.ireps.gov.in](http://www.ireps.gov.in)) and to have user ID & password.

[www.ireps.gov.in](http://www.ireps.gov.in) is the only website for submission of tender.

Tender shall be submitted through Online mode only at [www.ireps.gov.in](http://www.ireps.gov.in). Tender submitted by any other mode will not be accepted. All the required documents (legible) as mentioned in Check List have to be uploaded along with the offer on [www.ireps.gov.in](http://www.ireps.gov.in) **failing which, the bid shall not be considered for further evaluation.**

- 1.2.7 Tenders shall be opened at the address given below on scheduled date & time in the presence of the tenderers or their authorized representatives intending to attend the opening.

Address of Office of the Chief General Manager/ Noida (*for opening of tenders*): -  
Chief General Manager/Noida, D-89, 1<sup>st</sup> Floor, Sector-2, Noida-201301, U.P.

All the Bids received shall be opened on the date and time mentioned above in the tender notice. Bid of the bidders shall be opened through process of e-tendering. The sequence of opening shall be:

- i) Earnest Money Deposit (*EMD*)
- ii) Technical offer.
- iii) Financial offer (*at a later stage after scrutiny & finalization of acceptable Technical Bid*)

Tender shall be submitted as per “General Instructions to Tenderers” forming as part of the complete tender documents.

- 1.2.8 **Any tender received without Earnest money and cost of tender documents in the form as specified in the tender documents shall not be considered and shall be summarily rejected.**

- 1.2.9 DFCCIL reserves right to cancel the tender before submission/opening of tender, postpone the tender submission / opening date and to accept / reject any or all tenders without assigning any reason thereof. DFCCIL's assessment of suitability as per eligibility criteria shall be final and binding.

- 1.2.10 Tenderers may note that they are liable to be disqualified at any time during tendering process in case, any of the information furnished by them is not found to be true. EMD of such tenderers shall be forfeited & the decision of DFCCIL in this regard shall be final and binding.

- 1.2.11 DFCCIL reserves the right to pre-qualify the bidder(s) provisionally based on the documents submitted by them in technical bid. Financial bids of only those bidders would be opened, whose technical offers are found acceptable. In the event of any document being found false (*at a later stage*), the provisional qualification shall stand withdrawn, and the next lower bidder shall automatically come to the position of such disqualified bidder. Also, action against such disqualified tenderer shall be taken as per the provisions of the Tender.

- 1.2.12 Information as required as per various Forms to tender document should be submitted by the tenderers without fail strictly as per formats.

- 1.2.13 The validity of offer shall be **120 days** from the date of opening of the tender.

- 1.2.14 Transfer of the tender document purchased by intending tenderer to another tenderer is not admissible. Tenderer can submit tenders only on the documents purchased /downloaded from website: [www.ireps.gov.in](http://www.ireps.gov.in) by them.
- 1.2.15 Tenderers must read all instructions regarding E-Tendering process as mentioned in “Learnig centre under E-Tender: Works , 1. “Instructions to Contractors” available on [www.ireps.gov.in](http://www.ireps.gov.in) and INSTRUCTION TO TENDERERS Part I, Chapter III of the Tender Document.
- 1.2.16 Tenderers are advised to regularly visit the E-Tender Portal ([www.ireps.gov.in](http://www.ireps.gov.in)) for information regarding tender, corrigendum, addendum (if any) etc.
- 1.2.17 Joint Venture are allowed in terms of Para 1.3.19 of Part-I, Chapter-III of the Tender Document.**
- 1.2.18 The rates quoted by the contract or are deemed to be inclusive of site clearance, setting outwork, profile, setting lay out on ground, establishment of reference benchmark(s), installing various signage, taking spotlevels, survey with total station, construction of all safety and protection devices, compulsory use of helmet and safety shoes, and other appropriate safety gadgets by workers, imparting continuous training for all the workers, barriers, preparatory works, construction of clean, hygienic and well ventilated workers housings in sufficient numbers working during monsoon or odd season, working beyond normal hours, working at all depths, height, lead, lift, levels and location etc. and any other unforeseen but essential incidental works required to complete this work. *Nothing extra shall be payable* on this account and *no extension of time* for completion of work shall be granted on these accounts.
- 1.2.19 *In the estimated value of tender, GST @ 18% has been taken on the basic value. The basic value is inclusive of all taxes, duties and levies except GST. The % (above/below/at par) rates quoted by the tenderer shall apply on the basic value. The GST as legally leviable and payable by the Bidder under the provisions of applicable law/act shall be paid extra by DFCCIL.***
- Therefore, the Bidders should quote their rates after considering the Input Tax Credits on their input materials and services. Hence, Bidders should ensure that, full benefit of Input Tax Credit (ITC) likely to be availed by them is duly considered while quoting their rates.*
- If any cost implication to DFCCIL is occurred on GST account because of Contractor’s default in filing of GST returns such as no GST number, wrong GST number, mismatch of GST number etc., the same shall be recovered from the Contractor’s bill or any other pending/future bill.*
- 1.2.20 Price Variation Clause (PVC) will not be applicable for this work. Due to any reason, if the contract period extends beyond 12 months, even in that case, Price Variation clause shall not be applicable.**
- 1.2.21 Mobilization and Secured Advance will not be applicable for this work.**

**Chief General Manager/Noida  
For & on behalf of DFCCIL**

# **PART-I**

## **CHAPTER-III**

### **PREAMBLE & GENERAL INSTRUCTIONS TO TENDERERS**

## PART-I

### Chapter- III

#### PREAMBLE & GENERAL INSTRUCTIONS TO TENDERERS

##### 1.3.1 Introduction

###### (i) General

Ministry of Railways (MoR) established the Dedicated Freight Corridor Corporation of India Limited (DFCCIL), a Schedule “A” Public Sector Undertaking wholly owned by Ministry of Railways, Govt. of India to undertake planning & development, mobilization of financial resources, construction, maintenance and operation of the Dedicated Freight Corridor Railway line project. DFCCIL was incorporated as a company under the Companies Act 1956 on 30th October 2006.

This company is now actively engaged in the implementation of Computerized Multi Modal High Axle Load Dedicated Freight Corridor Project between Delhi-Mumbai under the Western DFC Corridor and Ludhiana-Delhi-Kolkata under the Eastern DFC Corridor.

The DFC Railway line project will also restore the Indian Railway’s competitive strength in the freight transportation market and emerge as the *major low carbon and energy efficient transport system in the country*. It will drive the establishment of industrial corridors and logistic parks along its alignment and play a crucial role in supporting India’s growing economy.

###### (ii) “DFCCIL Integrated office cum Residential complex Project ”

###### Concept

For construction, operations and maintenance of Dedicated Freight Corridor Project, DFCCIL management desired to build his own “**DFCCIL Integrated office cum Residential complex**” in phased manner. The complex desires to be very vibrant and dynamic which should be self-contained and self- sustaining, with state of art physical, social and economic infrastructure. This complex *would be developed on Green Building Concept* and will be eco-friendly, energy efficient, modern and integrated with its inspiring existing landscapes.

“**DFCCIL Integrated Office Cum Residential Complex**” is a Pre-Certified GRIHA 5 Star Rating Complex situated at Noida-Greater Noida Expressway in Sector-145, Noida. The DFC complex comprises of Corporate office buildings, Heavy Haul Training Insititue, Club, Rest Houses and Residential Buildings as per the Master Plan approved by Noida Authority.

###### (iii) Project Background & Overview:

1. DFCCIL is in possession of free hold land admeasuring 16.8491 hectares (approx. 40 Acres) at Noida-Greater Noida Expressway in village Jhatta, Noida. The Master plan showing exact location, adjacent features and boundaries of the land etc is provided below. DFCCIL is fully entitled to develop the said land. The land is almost flat and located in village Jhatta, G.B. Nagar (U.P).

2. On the western & southern side, the site is bounded by Noida-Greater Noida Expressway & Noida-Gr. Noida Metro Line and on the eastern site it is bounded by Hindon river, its bund & forest area. The DFCCIL site lies between two functional Metro Stations Sec145 & Sec-146 Noida of Noida-Greater Noida metro line.
3. The plot enjoys excellent linkages with other parts of Noida & Greater Noida and is approachable by Noida-Greater Noida Expressway and is approx. 16 km from Mahamaya Flyover in Noida.

**(iv) Project Master Layout Plan:**



**(v) Current Status of project:**

In Phase-I of the project, one Corporate Office building of built up area around **20,000 sqm** and Heavy Haul Reaserch Insitute HHRI Complex comprises of Admin Building (G+3)-**3,541 sqm** Hostel Building (G+5)-**5,108 sqm** and General Lab Building are presently under construction in this DFC Complex. The tenders for civil work for the above buildings were already floated and the work under these contracts is near to completion.

**Now, this current tender is invited for the work of “Interior Fitout works such as False Ceiling, Partitioning, Wood work, Electrical, HVAC, IT, Furniture and other allied works for under construction DFCCIL HHRI Building complex and 2<sup>nd</sup> Floor of CTP-14 office at Sec-145, Noida.**

**(vi) Scope of Work**

Chief General Manager, Dedicated Freight Corridor Corporation of India Limited, D-89, 1st Floor, Sector-2, Noida-201301 India, hereinafter referred to as 'DFCCIL' is inviting E-Tenders from Firms/ Companies/Joint Ventures having requisite experience and financial capacity for execution of the following work:

**Interior Fitout works such as False Ceiling, Partitioning, Wood work, Electrical, HVAC, IT, Furniture and other allied works for under construction DFCCIL HHRI Building complex and 2<sup>nd</sup> Floor of CTP-14 office at Sec-145, Noida.**

The details of the building for which scope of work (as mentioned below) would be executed is as under:-

S. No.	Name of Building	No. of Stories	Approx. Built-up area (sqmt)
1	Admin Block of HHRI	G+3	3,541
2	Hostel Block of HHRI	G+5	5,108
3	2 <sup>nd</sup> Floor of CTP-14-14 Office	G+2	490

The brief scope of work is given below:-

- Flooring
- Internal Painting.
- False ceiling.
- Partitioning, Wood work and Wall Panelling.
- Furniture of Admin Block, Hostel Block & 2<sup>nd</sup> floor of CTP-14 Office.
- Supply and placing of Kitchen equipment in Cafeteria of Hostel Block.
- Fixing of internal and external signages.
- General Electrical works comprising of Internal wiring, Lighting fixtures, MV Panels, DB installation, HT/LT Cabling & Earthing etc.
- Lift work including supplying and installation as per design specifications including obtaining NOC from the lift inspector, etc.
- HVAC Works consisting of VRV system, ducting, piping, insulation, ventilation fans, related electrical work etc.
- Low Voltage works such as Fire Alarm System, Public Announcement System, Access Control System, CCTV, IT Networks, IP PBX etc.
- Other ancilliary works required for commissioning of the HHRI Complex.

**1.3.2 General Instructions (for only E-Tendering system):**

Submission of Online Bids is mandatory for this Notice Inviting Tender. E-Tendering is a new methodology for conducting Public Procurement in a transparent and secured manner.



Suppliers/Vendors will be the biggest beneficiaries of this new system of procurement. An E-Tendering portal of Dedicated Freight Corridor Corporation of India (DFCCIL) introduced for the process of E-Tendering which can be accessed on <http://www.ireps.gov.in>. (*refer in the BID DOCUMENTS*)

Words in capital and not defined in this document shall have the same meaning as in “BID DOCUMENT”.

**A) ACCESSING/OBTAINING/PURCHASING PROCESS OF TENDER DOCUMENT:**

- (i) It is mandatory for all the Tenderers to have class-III digital signature or as specified by IREPS (in the name of person who will sign the Bid and will submit the online tender and is authorized to do so) certified from any of the licensed certifying agency (“CA”) to participate in E-Tendering of DFCCIL [*Tenderers can see the list of licensed CAs from the link [www.cca.gov.in](http://www.cca.gov.in)*].
- (ii) To participate in the E-Tender, it is mandatory for the Tenderers to get themselves registered with the IREPS ([www.ireps.gov.in](http://www.ireps.gov.in)) and to have user ID & password.
- (iii) [www.ireps.gov.in](http://www.ireps.gov.in) is the only website for submission of online tender. The detailed instructions of E-Tendering can be read through website [www.ireps.gov.in](http://www.ireps.gov.in) on “Learnig centre under E-Tender: Works , 1. Instructions to Contractors” containing the detailed guidelines for E-Tendering.
- (iv) Tender shall be submitted through online mode only at [www.ireps.gov.in](http://www.ireps.gov.in). Tender submitted by any other mode will not be accepted.
- (v) All the required documents (legible) as mentioned in Check list S.No. 1 to 19 have to be uploaded along with the offer on [www.ireps.gov.in](http://www.ireps.gov.in), **falling which, the bid shall be liable to be rejected and shall not be considered for further evaluation.**
- (vi) The Addendum/Corrigendum, if any; shall be hosted on the website [www.ireps.gov.in](http://www.ireps.gov.in) only.
- (vii) The supporting documents for Eligibility Criteria are essentially required to be uploaded on the website [www.ireps.gov.in](http://www.ireps.gov.in) as bid shall be accepted through Online mode only.
- (viii) Tenderers are required to give Un-Conditional offers. A Conditional Offer is liable to be rejected. DFCCIL reserves the right to modify, expand, restrict, cancel, reject and re-float tender without assigning any reasons whatsoever.
- (ix) The Tenderers shall closely peruse all the clauses, instructions, terms and conditions, scope of work, specification etc. as indicated in the Tender Document before quoting the rates. If the contractor have any doubt about the meaning of any portion of the Tender Document or find discrepancies/omissions in the tender document issued or required clarification, he shall at once contact the authority inviting the tender for clarification at least ten days before the due date of submission of the tender.
- (x) Bid document shall be accompanied by all the documents required to be submitted as specified in the Tender Document along with all Addendums and Corrigendum.

- (xi) All Bids shall be submitted in accordance with the instructions contained in the Tender Document (Bid Document). Non-Compliance of any of the instructions contained in the Tender Document is liable in Bid being rejected.
- (xii) After award of contract of the Successful Contractor, if it is observed that there is any discrepancy or ambiguity about any terms and conditions mentioned in the Tender Document, the interpretation of same given by DFCCIL shall be considered as final and binding.
- (xiii) Order of precedence of Documents: In tender/contract, in case of any difference, contradiction, discrepancy, with regard to conditions of tender/contract, specifications, drawings, bill of quantities etc., forming part of the tender/contract, the following shall be the order of precedence:
  - 1. Letter of Award
  - 2. Schedule of items, Rates & Quantities.
  - 3. Special Conditions of Contract.
  - 4. Technical Specifications as given in tender documents.
  - 5. Drawings, if any.
  - 6. General Conditions of Contract.
  - 7. Relevant BIS Codes.

For example, if any item is found common in Special Conditions of contract and General Conditions of Contract then the provision given in Special Conditions of Contract will prevail over General Conditions of Contract for the same item.
- (xiv) Contractor must fill up all the schedules and furnish all the required information on e-mode as per the instructions given in various sections of the Tender Document.
- (xv) Submission of a tender by a tenderer implies that he had read all the tender document including amendments/corrigendum if any, visited the site and made himself aware of the scope of the work to be done, local conditions and other factors having any bearing on the execution of the work.
- (xvi) DFCCIL reserves all rights to reject any tender including of those tenders who fail to comply with the instructions without assigning any reason whatsoever and does not bind itself to accept the lowest or any specific tender. The decision of DFCCIL in this regard shall be final and binding. Any failure on the part of the tenderer to observe the prescribed procedure and any attempt to canvass for the work will prejudice the tenderer's bid.
- (xvii) Tenderers may note that they are liable to be disqualified at any time during tendering process in case any of the information furnished by them is not found to be true. Earnest Money Deposit (EMD) of such tenderer shall be forfeited. The decision of the DFCCIL in this regard shall be final and binding.

- (xviii) Evaluation of tenders will be made on the basis of fulfilment of Eligibility Criteria mentioned in the Bid Document. However, DFCCIL reserves the right to seek any clarification from the contractor.

**B) PREPARATION & SUBMISSION OF TENDER:**

- a. **Document mentioned at S.No. 1 to 16** of the Check lists [*Technical Bid (Packet-A)*] should be scanned and uploaded as attachment at website ([www.ireps.gov.in](http://www.ireps.gov.in)). The detailed instructions of E-tendering can be read through website [www.ireps.gov.in](http://www.ireps.gov.in).
- b. Similarly, the **document mentioned at S.No. 17 & 18** of the Check list [*Technical Bid (Packet-A)*] should first be downloaded from E-Tender Portal (*in PDF Format*) and thereafter upload them to E-Tender Portal, through digital signature.
- c. **For Document No. 19** of the Check list [*Financial Bid (Packet-B)*], Financial Bid to be filled and submitted on [www.ireps.gov.in](http://www.ireps.gov.in) by following the steps available at E-Tender IREPS Portal.

**C) Modification/ Substitution/ Withdrawal of bids:**

- (i) Once bid is submitted, the tenderer will not be allowed to withdraw the offer.
- (ii) The tenderer can however modify their bid till closing time of tender. In case of revising the bid, the revised bid will supersede earlier bids and the latest bid will be considered for evaluation.

**D) DELETED:**

**E) OPENING AND EVALUATION OF BIDS:**

- (i) Opening of Bids will be done through online process at [www.ireps.gov.in](http://www.ireps.gov.in).
- (ii) E-Tender shall be opened Online at the address given below at the time and date as specified in Part-1 (Notice Inviting Tender) in the presence of Tenderers of their authorized representatives, if they choose to attend the Online Tender Opening.

**Address: Online Opening of Tender**

Dedicated Freight Corridor Corporation of India Ltd./Noida Unit, D-89, First Floor, Sector-2, Noida-201301.

- (iii) For participating in the tender, the authorized signatory holding Power of Attorney shall be the Digital Signatory. In case the authorized signatory, holding Power of Attorney and Digital Signatory are not the same, the ***bid shall be considered non-responsive.***
- (iv) The Authority shall Open Bid Documents received in electronic form online on the date and time as specified in the NIT.

- (v) The Authority will subsequently examine and evaluate the Technical Bids in accordance with the provisions set out in the BID DOCUMENTS.
- (vi) The Financial Bids will be opened only of the pre-qualified Bidders (*only after Technical evaluation*) & the date of opening of Financial Bids will be notified later on.

## **DISCLAIMER**

The Bidder must read all the instructions in the BID DOCUMENTS and ensure to complete the tender submission process in time as [www.ireps.gov.in](http://www.ireps.gov.in) will stop accepting any online tender after tender closing due date and time as specified in the NIT.

The agency may visit the site on any working day to assess the site conditions and scope of work before submitting their offer.

### **1.3.3 About the Tender**

- (i) **Cost of the work:** The estimated cost of the tendered work is approximately **Rs. 16,45,83,829/- (Rs. 13,94,77,821/- + GST @ 18%)** (*Rupees Sixteen Crore Fourty Five Lakh Eighty Three Thousand Eight Hundred & Twenty Nine Only*).
- (ii) The tenderer(s) shall be governed by General Conditions of Contract (GCC), Preamble and General Instructions to Tenderers (ITT) and Special Conditions of Contract (SCC). Wherever, there is a conflict in any condition between GCC and Special Conditions of Contract mentioned in the tender documents, the condition mentioned in Special Conditions of Contract will prevail. However, Engineer's decision in this connection shall be final and binding.

Part-I, Chapter-IV and V of the tender document contains General Conditions of Contract and Special Conditions of Contract specific to this work and shall be applicable in the contract.

### **1.3.4 Form of Tender (Two Packet System of Tendering)**

With the view to access the tenders technically without being influenced by the financial bids, “Two packet system of tendering” shall be adopted. The Tender bid shall have to be submitted in **Two Packet System (through IREPS i.e. [www.ireps.gov.in](http://www.ireps.gov.in))**

#### **"Packet-A"**

Eligibility/Qualifying Element of the tender bid along with other requisite documents as mentioned in Technical bid (Packet-A) of Check List, Part-I Chapter-I of the Tender Document.

#### **"Packet-B"**

Price Element of tender bid with percentage above/below/at par on the Schedule of Prices duly filled in as mentioned in Financial bid (Packet-B) of Check List, Part-I Chapter-I of the Tender Document.

The technical bid (Packet-A) shall be opened on the date of tender opening and the detailed

scrutiny of Technical bid shall be carried out. The “Financial Bid” (Packet-B) shall be opened only of those tenderers who qualify in “Technical Bid”.

- 1.3.5** Provision of make in India policy 2017 issued by Govt. of India, as amended time to time, shall be followed for consideration of tenders.

### 1.3.6 Tender Document

This tender document consists of following four parts:

PART/CHAPTERS	DESCRIPTION
<b>PART – I</b>	
Chapter I	Check list of documents to be uploaded/submitted in the E-Tender
Chapter II	Notice Inviting E-Tender
Chapter III	Preamble and General Instructions to Tenderers
Chapter IV	General Conditions of Contract
Chapter V	Special Conditions of Contract
<b>PART – II</b>	Technical Specifications
<b>PART – III</b>	
Chapter I	Milestones and Time Schedule
Chapter II	Tender Forms

### 1.3.7 TENDER FORM (Second Sheet)

- Instructions to Tenderers and Conditions of Tender:** The following documents form part of Tender / Contract:
  - Tender Forms
  - Special Conditions/Specifications (enclosed)
  - Schedule of approximate quantities (enclosed)
  - Standard General Conditions of Contract and Standard Specifications (Works and Materials) of Indian Railways as amended/corrected upto latest correction slips.
  - CPWD Schedule of Rates as amended / corrected upto latest correction slips.
  - All general and detailed drawings pertaining to this work which will be issued by the Engineer/DFCCIL or his representatives (from time to time) with all changes and modifications.
- Drawings for the Work:** The Drawing for the work can be seen in the office of Chief General Manager/DFCCIL Noida at any time during the office hours. The drawings are only for the guidance of Tenderer(s). Detailed working drawings (if required) based generally on the drawing mentioned above, will be given by the Engineer or his representative from time to time.
- The Tenderer(s) shall quote his / their rates as a percentage above or below the Schedule of Rates of Tender and must tender for all the items shown in the Schedule of approximate quantities attached. The quantities shown in the attached Schedule are given as a guide and are approximate only and are subject to variation according to the needs of the DFCCIL. The DFCCIL does not guarantee work

under each item of the Schedule. The tenderer(s) shall quote rates / rebates only at specified place in online financial Bid. Any revision of rates / rebates submitted (quoted) through a separate letter whether enclosed with the bid (Tender Form) or submitted separately or mentioned elsewhere in the document other than specified place shall be summarily ignored and will not be considered.

4. Tenders containing erasures and / or alterations of tender documents are liable to be rejected. Any correction made by tender(s) in his/their entries must be attested by him / them.
5. The works are required to be completed within a period of **09 months** from the date of issue of acceptance letter.

### **1.3.8 Sale & Submission of Tender Document:**

#### **1.3.8.1 Cost of Tender document: -**

Tender document is available on [www.ireps.gov.in](http://www.ireps.gov.in) and the same can be downloaded and used as tender documents for submitting the offer. The cost of tender document as prescribed in the NIT shall be deposited online through payment gateway of [www.ireps.gov.in](http://www.ireps.gov.in) by the tenderer.

#### **1.3.8.2 Earnest Money Deposit: -**

- 1 (a) The tenderer shall be required to deposit earnest money with the tender for the due performance with the stipulation to keep the offer open till such date as specified in the tender, under the conditions of tender.
  - (i) The Earnest Money shall be rounded off to the nearest Rs. 100. This Earnest money shall be applicable for all mode of tendering.
  - (ii) Any firm recognized by Department of Industrial Policy and Promotion (DIPP) as 'Startups' shall be exempted from payment of earnest money deposit detailed above.
  - (iii) 100% Govt. owned PSUs shall be exempt from payment of earnest money deposit detailed above.
  - (iv) Labour Cooperative Societies shall deposit only 50% of above earnest money deposit detailed above.
- (b) It shall be understood that the tender documents have been sold/issued to the tenderer(s) and the tenderer(s) is/are permitted to tender in consideration of stipulation on his/their part, that after submitting his/their tender (subjected to the period being extended further), he will not resile from his offer or modify the terms and conditions, thereof in a manner not acceptable to DFCCIL. Should the tenderer fail to observe or comply with the foregoing stipulation, the amount deposited as earnest money for the due performance of the above stipulation, shall be forfeited by DFCCIL.
- (c) If his tender is accepted this earnest money mentioned in sub clause (a) above will be retained as part security for the due and faithful fulfillment of the contract in terms of Clause 16 of the Standard General conditions of Contract. The Earnest Money of other Tenderers shall, save as herein before provided, be returned to them, but the DFCCIL shall not be responsible for any loss or depreciation that may happen thereto while in their possession, nor be liable to pay interest thereon.
- (d) The tenderer must deposit the amount of Earnest Money for the amount prescribed, online through the payment gateway on [www.ireps.gov.in](http://www.ireps.gov.in) as mentioned in the NIT.

- (e) The tender must be accompanied by Earnest Money deposited through e-payment gateway or as mentioned as tender documents, failing which the tender **shall not be considered**. Any firm recognized by Department of Industrial Policy and Promotion (DIPP) as 'Startups' "shall be exempted from payment of Earnest Money on submission of Registration Certificate issued by appropriate authority. Tenderers received without Earnest Money in full in the manner prescribed above **shall be summarily rejected**.
- (f) The Tenderer(s) shall keep the offer open for a minimum period of 120 days from the date of opening of the Tender. It is understood that the tender documents have been issued to the Tenderer(s) and the Tenderer(s), is / are permitted to tender in consideration of the stipulation on his / their part that after submitting his / their tender subject to the period being extended further, if required by mutual agreement from time to time, he will not resile from his offer or modify the terms and conditions thereof in a manner not acceptable to DFCCIL. Should the tenderer fail to observe or comply with the foregoing stipulation, the amount deposited as Earnest Money for the due performance of the above stipulation, shall be forfeited to the DFCCIL.
- (g) DFCCIL reserves the rights of forfeiture of Earnest Money Deposit (EMD) in case of successful tenderers if: -
  - a. Does not execute the Contract Agreement within stipulated time: or
  - b. Does not submit Performance Security in the form of Bank Guarantee of the requisite value within stipulated time: or
  - c. Does not commence the work after receipt of Letter of Acceptance or date as specified in the Letter Acceptance.
  - d. Withdraws the offer during the period of validity/extended validity.
  - e. When any of the information furnished by the tenderer not found true.
  - f. If the work is terminated at any stage as per terms and conditions of the contract.

#### **1.3.8.3 Clause applicable for tender documents downloaded from Internet**

Tenderer/s are free to download tender documents at their own cost, for the purpose of perusal as well as for using the same as tender document for submitting their offer. **Master copy of the tender document will be available in the office of Chief General Manager, D-89, 1<sup>st</sup> Floor, Sector-2, Noida- 201301, U.P., India.**

After award of the work, an agreement will be drawn up. The agreement shall be prepared based on the master copy available in the office of Chief General Manager, Dedicated Freight Corridor Corporation of India Limited, D-89, 1<sup>st</sup> Floor, Sector-2, Noida- 201301, U.P., India and not based on the tender documents submitted by the Tenderer. In case of any discrepancy between the tender documents downloaded from the internet and the master copy, later shall prevail and will be binding on the Tenderers. No claim on this account shall be entertained.

- #### **1.3.8.4 Complete tender documents must be submitted online duly completed in all respect on [www.ireps.gov.in](http://www.ireps.gov.in) upto 15.00 Hrs on 14.12.2021. The "Packet-A (TECHNICAL BID)" will be opened at 15:30 Hrs on 14.12.2021 and read out in the presence of such tenderer(s) as is/are present. In case the intended date for opening of tenders is declared a holiday, the tenders will be opened on the next working day at the same time. Any modified date and time for submission of tenders shall be uploaded on [www.ireps.gov.in](http://www.ireps.gov.in). The detail procedure of tender opening will be as per para- 1.3.9.**

**1.3.8.5** The rates should be quoted in figures as well as in words. If there is variation between rates quoted in figures and in words, the rate quoted in 'words' shall be taken as correct. If more than one or improper rates are tendered for the same item, the tender is liable to be rejected.

**1.3.8.6** Tenders containing erasures and/or alteration of the tender documents are liable to be rejected. Any correction made by Tenderer(s) in his/their entries must be attested by him/them.

**1.3.8.7 Care in Submission of Tenders–**

- (a) (i) Before submitting a tender, the tenderer will be deemed to have satisfied himself by actual inspection of the site and locality of the works, that all conditions liable to be encountered during the execution of the works are taken into account with that the rates he enters in the tender forms are adequate and all-inclusive to accord with the provisions in Clause 37 of the Standard General Conditions of Contract for the completion of works to the entire satisfaction of the Engineer.
- (a) (ii) Tenderers will examine the various provisions of the Central Goods and Services Tax Act, 2017(CGST)/Integrated Goods and Services Tax Act, 2017(IGST)/Union Territory Goods and Services Tax Act, 2017(UTGST)/respective state's State Goods and Services Tax Act (SGST) also, as notified by Central/State Govt & as amended from time to time and applicable taxes before bidding. Tenders will ensure that full benefit of Input Tax (ITC) likely to be availed by them is duly considered while quoting rates.
- (a) (iii) The successful tenderer who is liable to be registered under CGST/IGST/UTGST/SGST Act shall submit GSTIN along with other details required under CGST/IGST/UTGST/SGST Act to DFCCIL immediately after the award of contract, without which no payment shall be released to the contractor. The contractor shall be responsible for deposition of applicable GST to the concerned authority.
- (a) (iv) In case, the successful tenderer is not liable to be registered under CGST/IGST/UTGST/SGST Act, the DFCCIL shall deduct the applicable GST from his/their bills under reverse charge mechanism (RCM) and deposit the same to the concerned authority.
- (b) When work is tendered for by a firm or company the tender shall be signed by the individual legally authorized to enter into commitments on their behalf.
- (c) The DFCCIL will not be bound by any power of attorney granted by the tenderer or by changes in the composition of the firm made subsequent to the execution of the contract. It may however, recognize such power of attorney and changes after obtaining proper legal advice, the cost of which will be chargeable to the contractor.

**1.3.8.8** The tenderers shall submit a copy of certificate stating that all their statements/ documents submitted along with bid are true and factual. Standard format of certificate to be submitted by the bidder is enclosed as **Form-1B**. Non submission of above certificate by the bidder shall result in **summarily** rejection of his/their bid. It shall be mandatorily incumbent upon the tenderer to identify, state and submit the supporting documents duly self attested by which they/he is qualifying the Qualifying Criteria mentioned in the Tender Document.

**1.3.9 Opening of Tender:** Two packet system of tendering shall be adopted in this tender

- (a) Tender will be opened at **15:30 hrs on 14.12.2021**, in the office of Chief General Manager/Noida, **Dedicated Freight Corridor Corporation of India Limited, D-89, 1<sup>st</sup> Floor, Sector-2, Noida-201301, U.P, India** in the presence of the tenderers or their representatives as may be present at the prescribed date and time.



- (b) After the opening of “**TECHNICAL BID**” (**Packet-A**) of all the eligible tenderers, these bids shall be scrutinized and analysed. If, found necessary by the Employer, the tenderers shall be asked to furnish clarifications and the Employer may also hold discussions with the tenderers after giving due notice. The names of the tenderers whose bid are considered complete and meet eligibility criteria shall be shortlisted.
- (c) The **FINANCIAL BID(Packet-B)** shall be opened on a subsequent date and time duly notified well in advance. The Financial bids of only those tenderers shall be opened who are shortlisted after scrutiny of their Technical bid. The Financial bid of the tenderers who do not qualify during scrutiny of Technical bid shall not be opened. The time of opening, date and venue shall be advised to qualified tenderers well in advance to enable them to depute their representative.

#### **1.3.10 Validity of Tender: -**

Tenderer shall keep his offer open for a minimum period of **120 days** from the date of opening of the tender or as mentioned in the Tender Notice.

#### **1.3.11 Execution of Contract Agreement: -**

The Tenderer whose tender is accepted shall be required to appear in person at the office of **Chief General Manager, Dedicated Freight Corridor Corporation of India Limited**, D-89, 1<sup>st</sup> Floor, Sector-2, Noida-201301, as the case may be, or if tenderer is a firm or corporation, a duly authorized representative shall appear and execute the contract agreement within 07 days of notice from DFCCIL that the contract agreement is ready. The Contract Agreement shall be entered into by DFCCIL only after submission of valid Performance Guarantee by the Contractor. Failure to do so shall constitute a breach of the agreement affected by the acceptance of the tender. In such cases, the DFCCIL may determine that such tenderer has abandoned the contract and there upon his tender and acceptance thereof shall be treated as cancelled and the DFCCIL shall be entitled to forfeit the full amount of the earnest money and other dues payable to the Contractor under this contract. The failed Contractor shall be debarred from participating in the re-tender for that work.

Every contract shall be complete in respect of the documents it shall so constitute. Not less than 2 copies of the contract document shall be signed by the competent authority and the Contractor and one copy given to the Contractor.

#### **1.3.12 Security Deposit on Acceptance of Tender:**

The security deposit/rate of recovery/mode of recovery on acceptance of tender shall be as per the Para 16. (1) to 16. (3) of General Conditions of Contract (GCC).

#### **1.3.13 Right of DFCCIL to Deal with Tenders**

- (a) The DFCCIL reserves the right of not to invite tenders for any of DFCCIL work or works or to invite open or limited tenders and when tenders are called to accept a tender in whole or in part or to reject any tender or all tenders without assigning reasons for any such action.
- (b) The authority for the acceptance of the tender will rest with the DFCCIL. It shall not be obligatory on the said authority to accept the lowest tender or any other tender and no tenderer(s) shall demand any explanation for the cause of rejection of his/their tender nor the DFCCIL undertake to assign reasons for declining to consider or reject any particular tender or tenders.

- (c) If the tenderer(s) deliberately gives / give wrong information in his / their tender or creates / create circumstances for the acceptance of his / their tender, the Railway reserves the right to reject such tender at any stage.
- (d) If the tenderer(s) expire(s) after the submission of his / their tender or after the acceptance of his /their offer, the Railway shall deem such tender cancelled. If a partner of a firm expires after the submission of their tender or after the acceptance of their tender, the Railway shall deem such tender as cancelled, unless the firm retains its character.

### 1.3.14 Eligibility Criteria

#### 1.3.14.1 Technical Eligibility Criteria

- (a) The tenderer must have successfully completed any of the following during last 07 (seven) years, ending last day of month previous to the one in which tender is invited:

S. No.	Work	Advertised value of Tender
1.	Interior Fitout works such as False Ceiling, Partitioning, Wood work, Electrical, HVAC, IT, Furniture and other allied works for under construction DFCCIL HHRI Building complex and 2 <sup>nd</sup> Floor of CTP-14 office at Sec-145, Noida.	<b>Rs. 16,45,83,829/-</b> <b>(Rs. 13,94,77,821/- + GST @ 18%)</b>

Three similar works each costing not less than the amount equal to 30% of advertised value of tender,  
or

Two similar works each costing not less than the amount equal to 40% of advertised value of tender,  
or

One similar work each costing not less than the amount equal to 60% of advertised value of tender.

The definition of “**Similar Work**” for the above stated work is as below:

**Similar work means Contracts having “Interior Fitout works including Electrical works inside the Office/Institutional building”.**

#### **Note for Item 1.3.14.1:**

1. Work experience certificate from private individual shall not be considered. However, in addition to work experience certificates issued by any Govt. Organisation, work experience certificate issued by Public listed company having average annual turnover of Rs 500 crore and above in last 3 financial years excluding the current financial year, listed on National Stock Exchange or Bombay Stock Exchange, incorporated/registered at least 5 years prior to the date of opening of tender, shall also be considered provided the work experience certificate has been issued by a person authorized by the Public listed company to issue such certificates.

In case tenderer submits works, experience certificate issued by Public listed company, the

tenderer shall also submit along with work experience certificate, the relevant copy of work order, bill of quantities, bill wise details of payment received duly certified by Chartered Accountant, TDS certificates for all payments received and copy of final/last bill paid by company in support of above work experience certificate.

**Note:**

- 1. It shall be the responsibility of the tenderer to submit proper credential certificate from the client indicating the value of “Similar Work” as defined in Para 1.3.14.1 (a) above. In case, such details are not submitted by the tenderer, the tender is liable to be rejected.**
2. Value of complete work done by a member in an earlier JV Firm shall be reckoned only to the extent of the concerned member’s share in that JV firm for the purpose of satisfying his or her compliance to the above-mentioned technical eligibility criteria in the tender under consideration.
3. In case the tenderer (s) is a partnership firm, the work experience shall be in the name of partnership firm only.
- 4. *For judging the Technical eligibility works which had been executed for the government/ semi-government organization/PSU/Public listed company (as mentioned in the Note of para 1.3.14.1 above) will only be considered.***

**1.3.14.2 Financial Eligibility Criteria**

The tenderer must have received contractual payments in the three previous financial years and the current financial year upto the date of inviting of tender, at least 150% of the advertised value of the Tender. The tenderers shall submit Certificate to this effect which may be an attested certificate from the concerned department/Client or Audit Balance Sheet duly certified by the Chartered Accountant/UDIN certificate from Chartered Accountant duly supported by **Audited Balance sheets**.

Note for **1.3.11.2**: Client certificate from other than govt Organization should be duly supported by Form 16A/26AS generated through TRACES of Income Tax Department of India.

**Note:**

1. Contractual payments received by a Member in an earlier JV firm shall be reckoned only to extent to the concerned member’s share in that JV Firm for the purpose of satisfying compliance of the above-mentioned financial eligibility criteria in tender under considerations.
2. In case the tenderer/s is a partnership firm, the turnover etc shall be in the name of partnership firm only.

**1.3.14.3** Credentials if submitted in foreign currency shall be converted into Indian currency i.e., Indian Rupee as under:

The conversion rate of US Dollars into Rupees shall be the daily representative exchange rates published by the Reserve Bank of India for the relevant date. Where, relevant date shall be as on the last day of month previous to the one in which tender is invited. In case of any other currency, the same shall first be converted to US Dollars as on the last day of month previous to the one in which tender is invited, and the amount so derived in US Dollars shall be converted into Rupees at the aforesaid rate. The conversion rate of such currencies shall be the daily representative exchange rates published by the International Monetary Fund for the relevant date.

**Explanation for clause 1.3.14 Eligibility Criteria:**

1. *In case a work is started prior to 07 (seven) years, ending last day of month previous to the one in which tender is invited, but completed in last 07 (seven) years, ending last day of month previous to the one in which tender is invited, the completed work shall be considered for fulfillment of credentials.*
2. *If a work is physically completed and completion certificate to this extent is issued by the concerned organization but final bill is pending, such work shall be considered for fulfillment of credentials.*
3. *If a part or a component of work is completed but the overall scope of contract is not completed, this work shall not be considered for fulfillment of technical credentials even if the cost of part completed work/component is more than required for fulfillment of credentials.*
4. In case a work is considered similar in nature for fulfilment of technical credentials, the overall cost of that work including PVC amount if any shall be considered and no separate evaluation for each component of that work shall be made to decide eligibility.
5. The value of final bill including PVC amount-if paid, or otherwise in case final bill is pending the contract cost in last approved variation statement plus PVC amount paid or cumulative amount paid up to last on-account bill including PVC amount and statutory deductions whichever is less, shall be considered as the completion cost of work.
6. In case of newly formed partnership firm, the credentials of individual partners from previous propriety firm(s) or dissolved previous partnership firm(s) or split previous partnership firm(s), shall be considered only to the extent of their share in previous entity on the date of dissolution / split and their share in newly formed partnership firm. For example, a partner A had 30% share in previous entity and his share in present partnership firm is 20%. In the present tender under consideration, the credentials of partner A will be considered to the extent of  $0.3 \times 0.2 \times \text{value of the work done in the previous entity}$ . For this purpose, the tenderer shall submit along with his bid all the relevant documents which include copy of previous partnership deed(s), dissolution deed(s) and proof of surrender of PAN No.(s) in case of dissolution of partnership firm(s) etc.
7. In case of existing partnership firm, if any one or more partners quit the partnership firm, the credentials of remaining partnership firm shall be re-worked out i.e., the quitting partner(s) shall take away his credentials to the extent of his share on the date of quitting the partnership firm (e.g. in a partnership firm of partners A, B & C having share 30%, 30% & 40% respectively and credentials of Rs 10 crore; in case partner C quits the firm, the credentials of this partnership firm shall remain as Rs 6 crore). For this purpose, the tenderer shall submit along with his bid all the relevant documents which include copy of previous partnership deed(s), dissolution deed(s) and proof of surrender of PAN No.(s) in case of dissolution of partnership firm(s) etc.
8. In case of existing partnership firm if any other partner(s) joins the firm, the credentials of partnership firm shall get enhanced to the extent of credentials of newly added partner(s) on the same principles as mentioned in item 6 above. For this purpose, the tenderer shall submit along with his bid all the relevant documents which include copy of previous partnership deeds, dissolution/splitting deeds and proof of surrender of PAN No.(s) in case of dissolution of partnership firm etc.
9. Any partner in a partnership firm cannot use or claim his credentials in any other firm without leaving the partnership firm i.e., In a partnership firm of A&B partners, A or B partner cannot use credentials of partnership firm of A&B partners in any other partnership firm or propriety firm without leaving partnership firm of A&B partners.
10. In case a partner in a partnership firm is replaced due to succession as per succession law, the proportion of credentials of the previous partner will be passed on to the successor.
11. If the percentage share among partners of a partnership firm is changed, but the partners remain the same, the credentials of the firm before such modification in the share will continue to be considered for the firm

as it is without any change in their value. Further, in case a partner of partnership firm retires without taking away any credentials from the firm, the credentials of partnership firm shall remain the same as it is without any change in their value.

12. In a partnership firm “AB” of A&B partners, in case A also works as propriety firm “P” or partner in some other partnership firm “AX”, credentials of A in propriety firm “P” or in other partnership firm “AX” earned after the date of becoming a partner of the firm AB shall not be added in partnership firm AB.
13. In case a tenderer is LLP, the credentials of tenderer shall be worked out on above lines similar to a partnership firm.
14. In case company A is merged with company B, then company B would get the credentials of company A also.]

#### **1.3.14.4 Tenderer Credentials:**

The tenderer shall submit documents testifying tenderer’s previous experience and financial status in support of their technical and financial eligibility, which are acceptable to DFCCIL, alongwith the tender:

- (a) Certificates and testimonials regarding contracting experience for the type of job for which tender is invited with list of works carried out in the past. For **Technical eligibility criteria**, the details will be submitted in “**Form No.2A/2AA**” along with supporting documents.
- (b) Certificates which may be an attested Certificate from the client, Audited balance sheet duly certificate by the Chartered accountant etc regarding contractual payments received in the past. For Financial eligibility criteria, the details will be submitted in “**Form No.2B**” along with supporting documents.
- (c) Applicant’s Party Information Form “**Form No.2C**”
- (d) The list of personnel / organization on hand and proposed to be engaged for the tendered work. Similarly list of Plant & Machinery available on hand and proposed to be inducted and hired for the tendered work.
- (e) A copy of certificate stating that they are not liable to be disqualified and all their statements/documents submitted alongwith bid are true and factual. Standard format of the certificate to be submitted by the bidder is enclosed as **Form-1B**. Non submission of a copy of certificate by the bidder shall result in summarily rejection of his/their bid. It shall be mandatorily incumbent upon the tenderer to identify, state and submit the supporting documents duly self attested by which they/he are/is qualifying the Qualifying Criteria mentioned in the Tender Document.
- (f) The tenderer shall submit the completion certificates/certified completion certificates from the client(s) or Photostat of original certificates of client. These certificates should indicate the details of works carried out and successful commissioning of similar type of work executed by the tenderer. *Completion certificate from Govt. organisation/Semi Govt. organizations/PSUs/Public Listed Company (as mentioned in Note for Item 1.3.14.1) will only be accepted. The certificate from Private individual/Private Company for whom such works are executed shall not be*

**accepted.** In case, the work is executed for Public Listed Company as mentioned above, copy of work order, bill of Quantity, Billwise details of payment received duly certified by Chartered Accountant, TDS certificates for all payments received and copy of final/last bill paid by Company in support of above work experience certificate shall be submitted.

- (g) Tenderer shall submit a statement of contractual payments received during last three financial years and current financial year on the prescribed Performa as per **“Form No. 2B” duly certified by Chartered Accountant in the form of UDIN Certificate.** The above certificate shall be based on the form 16-A issued by the employer i.e. the certificate of deduction of tax at source as per Income Tax Act, 1961 and Form-26AS issued by Income Tax Department. The photocopies of Form 16-A/Form-26AS shall be enclosed or a certificate from auditor or audited balance sheet certified by Chartered Accountant clearly indicating the contractual amount received. DFCCIL may invite the Tenderer for offline/online verification of Form-16A & Form-26AS.
- (h) The DFCCIL reserves the right to verify all statements, information and documents submitted by the bidder in his tender offer, and the bidder shall, when so required by the DFCCIL, make available all such information, evidence and documents as may be necessary for such verification. Any such verification or lack of such verification, by the DFCCIL shall not relieve the bidder of its obligations or liabilities hereunder nor will it affect any rights of the DFCCIL there under.
- (i) (i) In case of any information submitted by tenderer is found to be false forged or incorrect at any time during process for evaluation of tenders, it shall lead to forfeiture of the tender Earnest Money Deposit besides banning of business for a period of upto five years.
- (ii) In case of any information submitted by tenderer is found to be false forged or incorrect after the award of contract, the contract shall be terminated. Earnest Money Deposit (EMD), Performance Guarantee and Security Deposit available with the railway shall be forfeited. In addition, other dues of the contractor, if any, under this contract shall be forfeited and agency shall be banned for doing business for a period of upto five years.

**1.3.14.5** Non-compliance with any of the conditions set forth therein above is liable to result in the tender being rejected.

#### **1.3.15 Execution of Contract Documents:**

The successful Tenderer(s) shall be required to execute an agreement with the DFCCIL for carrying out the work according to Standard General Conditions of Contract, Special Conditions/Specifications annexed to the tender and Standard Specifications (Works and Materials) of CPWD/DFCCIL as amended/corrected upto latest correction slips, mentioned in tender form.

#### **1.3.16 Documents to be submitted alongwith Tender:**

(i) The tenderer shall clearly specify whether the tender is submitted on his own (Proprietary Firm) or on behalf of a Partnership Firm / Company / Joint Venture (JV) / Registered Society / Registered Trust/ HUF etc. The tenderer(s) shall enclose the attested copies of the constitution of their concern, and copy of PAN Card along with their tender. Tender Documents in such cases are to be signed by such persons as may be legally competent to sign them on behalf of the firm, company, association, trust or society, as the case may be.

(ii) Following documents shall be submitted by the tenderer:

**(a) Sole Proprietorship Firm:**

- (i) An undertaking that he is not blacklisted or debarred by Railways/DFCCIL or any other Ministry/ Department of Govt. of India from participation in tender on the date of opening of bids, either in individual capacity or as a member of the partnership firm or JV in which he was/ is a partner/member. Concealment / wrong information in regard to above shall make the contract liable for determination under Clause 62 of the General Conditions of Contract.
- (ii) All other documents in terms of explanatory notes in clause 1.3.14 above.

**(b) HUF:**

- (i) A copy of notarized affidavit on Stamp Paper declaring that he who is submitting the tender on behalf of HUF is in the position of 'Karta' of Hindu Undivided Family (HUF) and he has the authority, power and consent given by other members to act on behalf of HUF.
- (ii) An undertaking that the HUF is not blacklisted or debarred by Railways/DFCCIL or any other Ministry / Department of Govt. of India from participation in tender on the date of opening of bids, either in individual capacity or as a member of the partnership firm or JV in which HUF was/ is a partner/member. Concealment / wrong information in regard to above shall make the contract liable for determination under Clause 62 of the General Conditions of Contract.
- (iii) All other documents in terms of explanatory notes in clause 1.3.14 above.

**(c) Partnership Firm:**

- (i) The tenderer shall submit documents as mentioned in Clause 1.3.20 of the Part-I, Chapter-III of the Tender Document.

**(d) Joint Venture (JV):** The tenderer shall submit documents as mentioned in Clause 1.3.19 of the Part-I, Chapter-III of the Tender Document.

**(e) Company registered under Companies Act 2013:**

- (i) The copies of MOA (Memorandum of Association) / AOA (Articles of Association) of the company
- (ii) A copy of Certificate of Incorporation
- (iii) A copy of Authorization/Power of Attorney issued by the Company (backed by the resolution of Board of Directors) in favour of the individual to sign the tender on behalf of the company and create liability against the company.
- (iv) An undertaking that the Company is not blacklisted or debarred by Railways/DFCCIL or any other Ministry / Department of Govt. of India from participation in tender on the date of opening of bids, either in individual capacity or as a member of the partnership firm or JV in which the Company was / is a partner/member. Concealment / wrong information in regard to above shall make the contract liable for determination under Clause 62 of the General Conditions of Contract.
- (v) All other documents in terms of explanatory notes in clause 1.3.14 above.

**(f) LLP (Limited Liability Partnership):** If the tender is submitted on behalf of a LLP registered under LLP Act-2008, the tenderer shall submit along with the tender:

- (i) A copy of LLP Agreement
- (ii) A copy of Certificate of Incorporation
- (iii) A copy of Power of Attorney/Authorization issued by the LLP in favour of the individual to sign the tender on behalf of the LLP and create liability against the LLP.

- (iv) An undertaking that the LLP is not blacklisted or debarred by Railways or any other Ministry / Department of Govt. of India from participation in tender on the date of opening of bids, either in individual capacity or as a member of JV in which the LLP was / is a member. Concealment / wrong information in regard to above shall make the contract liable for determination under Clause 62 of the General Conditions of Contract.
- (v) All other documents in terms of explanatory notes in clause 1.3.14 above.

**(g) Registered Society & Registered Trust:** The tenderer shall submit:

- (i) A copy of the Certificate of Registration
- (ii) A copy of Deed of Formation
- (iii) A copy of Power of Attorney in favour of the individual to sign the tender documents and create liability against the Society/Trust.
- (iv) All other documents in terms of explanatory notes in clause 1.3.14 above.
- (v) If it is NOT mentioned in the submitted tender that tender is being submitted on behalf of a Sole Proprietorship firm/ Partnership firm/ Joint Venture/ Registered Company etc., then the tender shall be treated as having been submitted by the individual who has signed the tender.
- (vi) After opening of the tender, any document pertaining to the constitution of Sole Proprietorship Firm / Partnership Firm/ Registered Company/ Registered Trust / Registered Society / HUF etc. shall be neither asked nor considered, if submitted. Further, no suo moto cognizance of any document available in public domain (i.e., on internet etc.) or in Railway's/DFCCIL's record/office files etc. will be taken for consideration of the tender, if no such mention is available in tender offer submitted.
- (vii) A tender from JV/ Partnership firm etc. shall be considered only where permissible as per the tender conditions.
- (viii) The DFCCIL will not be bound by any change in the composition of the firm made subsequent to the submission of tender. DFCCIL may, however, recognize such power of attorney and changes after obtaining proper legal advice, the cost of which will be chargeable to the Contractor.

**1.3.17** The tenderer whether sole proprietor/ a company or a partnership firm /joint venture (JV)/registered society/ registered trust/HUF etc if they want to act through agent or individual partner(s), should submit along with the tender, a copy of power of attorney duly stamped and authenticated by a Notary Public or by Magistrate in favour of the specific person whether he/they be partner(s) of the firm or any other person specifically authorizing him/them to submit the tender, sign the agreement, receive money, co-ordinate measurements through contractor's authorized engineer, witness measurements, sign measurement books, compromise, settle, relinquish any claim(s) preferred by the firm and sign "No Claim Certificate" and refer all or any disputes to arbitration. The above power of attorney shall be submitted even if such specific person is authorized for above purposes through partnership deed/ Memorandum of Understanding/ Article of Association or such other document, failing which tender is liable to be rejected.

**1.3.18 Employment/Partnership etc. of Retired Railway/DFCCIL Employees:**

- (a) Should a tenderer
  - i) be a retired Engineer of the gazetted rank or any other gazetted officer working before his retirement, whether in the executive or administrative capacity or whether holding a pensionable post or not, in the Engineering or any other department of any of the railways/DFCCIL owned and administered by the President of India for the time being, OR
  - ii) being partnership firm / joint venture (JV) / registered society / registered trust etc have as one of its partners a retired Engineer of the gazetted rank or any other gazetted officer working before his retirement, OR



iii) being an incorporated company have any such retired Engineer of the gazetted rank or any other gazetted officer working before his retirement as one of its directors

AND

in case where such Engineer or officer had not retired from government service at least 1 year prior to the date of submission of the tender

THEN

the tenderer will give full information as to the date of retirement of such Engineer or gazetted officer from the said service and as to whether permission for taking such contract, or if the Contractor be a partnership firm or an incorporated company, to become a partner or director as the case may be, has been obtained by the tenderer or the Engineer or officer, as the case may be from the President of India or any officer, duly authorized by him in this behalf, shall be clearly stated in writing at the time of submitting the tender.

- b) In case, upon successful award of contract, should a tenderer depute for execution of the works under or to deal matters related with this contract, any retired Engineer of gazette rank or retired gazetted officer working before his retirement in the Engineering or any other department of any of the Railways/DFCCIL owned and administered by the President of India for the time being, and now in his employment, then the tenderer will ensure that retired Engineer or retired gazetted officer had retired from government service at least 1 year prior to the date of his employment with tenderer and in case he had retired from service within a year then he possesses the requisite permission from the President of India or any officer, duly authorized by him in this behalf, to get associated with the tenderer.
- c) Should a tenderer or Contractor being an individual, have member(s) of his family or in the case of partnership firm/ company / joint venture (JV) / registered society / registered trust etc. one or more of his partner(s)/shareholder(s) or member(s) of the family of partner(s)/shareholder(s) having share of more than 1% in the tendering entity employed in gazetted capacity in the Engineering or any other department of the railway/DFCCIL, then the tenderer at the time of submission of tender, will inform the authority inviting tenders the details of such persons.

**Note:** - If information as required as per 1.3.18 (a), (b), (c) above has not been furnished, contract is liable to be dealt in accordance with provision of clause 62 of Standard General Condition of contract.

### **1.3.19 JOINT VENTURE (JV) IN WORKS TENDERS**

**Participation of Joint Venture (JV) in Works Tender:** This Clause shall be applicable for works tenders wherein tender documents provide for the same.

**1.3.19.1** Separate identity/name shall be given to the Joint Venture.

**1.3.19.2** Number of members in a JV shall not be more than three, if the work involves only one component and shall not be more than five, if the work involves more than one component. One of the members of the JV shall be its Lead Member who shall have a majority (at least 51%) share of interest in the JV. The other members shall have a share of not less than 20% each in case of JV with upto three members and not less than 10% each in case of JV with more than three members. In case of JV with foreign member(s), the Lead Member has to be an Indian firm/company with a minimum share of 51%.

**1.3.19.3** A member of JV shall not be permitted to participate either in individual capacity or as a member of another JV in the same tender.

**1.3.19.4** The tender form shall be purchased and submitted only in the name of the JV and not in the name of any constituent member. The tender form can however be submitted by JV or any of its constituent member or any person authorized by JV through Power of Attorney to submit tender.

**1.3.19.5** Earnest Money Deposit (EMD) shall be deposited by JV or authorized person of JV through e-payment gateway or as mentioned in tender document.

**1.3.19.6** A copy of Memorandum of Understanding (MoU) duly executed by the JV members on a stamp paper, shall be submitted by the JV along with the tender. The complete details of the members of the JV, their share and responsibility in the JV etc. particularly with reference to financial, technical and other obligations shall be furnished in the MoU. (The MoU format for this purpose is enclosed along with the tender).

**1.3.19.7** Once the tender is submitted, the MoU shall not be modified / altered / terminated during the validity of the tender. In case the tenderer fails to observe/comply with this stipulation, the full Earnest Money Deposit (EMD) shall be liable to be forfeited.

**1.3.19.8** Approval for change of constitution of JV shall be at the sole discretion of the DFCCIL. The constitution of the JV shall not be allowed to be modified after submission of the tender bid by the JV, except when modification becomes inevitable due to succession laws etc., provided further that there is no change in qualification of minimum eligibility criteria by JV after change of composition. However, the Lead Member shall continue to be the Lead Member of the JV. Failure to observe this requirement would render the offer invalid.

**1.3.19.9** Similarly, after the contract is awarded, the constitution of JV shall not be allowed to be altered during the currency of contract except when modification become inevitable due to succession laws etc. and minimum eligibility criteria should not get vitiated. Failure to observe this stipulation shall be deemed to be breach of contract with all consequential penal action as per contract conditions.

**1.3.19.10** On award of contract to a JV, a single Performance Guarantee shall be submitted by the JV as per tender conditions. All the Guarantees like Performance Guarantee, Bank Guarantee for Mobilization Advance, Machinery Advance etc. (if any) shall be accepted only in the name of the JV and no splitting of guarantees amongst the members of the JV shall be permitted.

**1.3.19.11** On issue of LOA (Letter of Acceptance), the JV entity to whom the work has been awarded, with the same shareholding pattern as was declared in the MOU/JV Agreement submitted along with the tender, shall be got registered before the Registrar of the Companies under 'The Companies Act -2013' (in case of Company) or before the Registrar/Sub-Registrar under the 'The Indian Partnership Act, 1932' (in case of Partnership Firm) or under 'The LLP Act 2008' (in case of LLP). A separate PAN shall be obtained for this entity. The documents pertaining to this entity including its PAN shall be furnished to the DFCCIL before signing the contract agreement for the work. In case the tenderer fails to observe/comply with this stipulation within 60 days of issue of LOA, contract is liable to be terminated. In case contract is terminated DFCCIL shall be entitled to forfeit the full amount of the Earnest Money Deposit and other dues payable to the Contractor under this contract. The entity so registered, in the registered documents, shall have, inter-alia,

following Clauses:

**1.3.19.11.1 Joint And Several Liability** - Members of the entity to which the contract is awarded, shall be jointly and severally liable to the DFCCIL for execution of the project in accordance with General and Special Conditions of Contract. The members of the entity shall also be liable jointly and severally for the loss, damages caused to the DFCCIL during the course of execution of the contract or due to non-execution of the contract or part thereof.

**1.3.19.11.2 Duration of the Registered Entity** - It shall be valid during the entire currency of the contract including the period of extension, if any and the maintenance period after the work is completed.

**1.3.19.11.3 Governing Laws** - The Registered Entity shall in all respect be governed by and interpreted in accordance with Indian Laws.

**1.3.19.12 Authorized Member** - Joint Venture members in the JV MoU shall authorize one of the members on behalf of the Joint Venture to deal with the tender, sign the agreement or enter into contract in respect of the said tender, to receive payment, to witness joint measurement of work done, to sign measurement books and similar such action in respect of the said tender/contract. All notices/correspondences with respect to the contract would be sent only to this authorized member of the JV.

**1.3.19.13** No member of the Joint Venture shall have the right to assign or transfer the interest right or liability in the contract without the written consent of the other members and that of the Railway/DFCCIL in respect of the said tender/contract.

**1.3.19.14** Documents to be enclosed by the JV along with the tender:

**1.3.19.14.1** In case one or more of the members of the JV is/are partnership firm(s), following documents shall be submitted:

- (i) A notarized copy of the Partnership Deed,
- (ii) A copy of consent of all the partners or individual authorized by partnership firm, to enter into the Joint Venture Agreement on a stamp paper,
- (iii) A notarized or registered copy of Power of Attorney in favour of the individual to sign the MOU/JV Agreement on behalf of the partnership firm and create liability against the firm.

**1.3.19.14.2** In case one or more members is/are HUF, the following documents shall be enclosed:

- (i) A copy of notarized affidavit on Stamp Paper declaring that he who is signing the affidavit on behalf of HUF is in the position of 'Karta' of Hindu Undivided Family (HUF) and he has the authority, power and consent given by other members to act on behalf of HUF.

**1.3.19.14.3** In case one or more members of the JV is/are companies, the following documents shall be submitted:

- (i) A copy of resolutions of the Directors of the Company, permitting the company to enter into a JV agreement,
- (ii) The copies of MOA (Memorandum of Association) / AOA (Articles of Association) of the company
- (iii) A copy of Certificate of Incorporation
- (iv) A copy of Authorization/copy of Power of Attorney issued by the Company (backed by the resolution of Board of Directors) in favour of the individual to sign the tender, sign MOU/JV Agreement on behalf of the company and create liability against the company

**1.3.19.14.4** All the Members of JV shall certify that they are not blacklisted or debarred by Railways/DFCCIL or any other Ministry/Department of the Govt. of India from participation in tenders/contract on the date of opening of bids either in their individual capacity or as a member of the JV in which they were/are members.

**1.3.19.14.5** All other documents in terms of explanatory notes in clause 1.3.14.1 to 1.3.14.5 above.

**1.3.19.15 Credentials & Qualifying Criteria: Technical, financial eligibility of the JV shall be adjudged based on satisfactory fulfillment of the following criteria:**

**1.3.19.15.1 Technical Eligibility Criteria** ('a' or 'b' mentioned hereunder):

The technical eligibility for the work as per para 1.3.14.1 above, shall be satisfied by either the 'JV in its own name & style' or any member having min 26% share. Each other member of JV shall have technical capacity of minimum 10% of the cost of work i.e., each JV member must have satisfactorily completed during the last 07 (seven) years, ending last day of month previous to the one in which tender is invited, one similar single work for a minimum of 10% of advertised value of the tender.

**Note for Clause 1.3.19.15.1:**

- (a) Value of a completed work done by a Member in an earlier JV shall be reckoned only to the extent of the concerned member's share in that JV for the purpose of satisfying his/her compliance to the above-mentioned technical eligibility criteria in the tender under consideration.

**1.3.19.15.2 Financial Eligibility Criteria**

The JV shall satisfy the requirement of "Financial Eligibility" mentioned at para 1.3.14.2 above. The "financial capacity" of the lead partner of JV shall not be less than 51% of the financial eligibility criteria mentioned at para 1.3.14.2 above.

The arithmetic sum of individual "financial capacity" of all the members shall be taken as JV's "financial capacity" to satisfy this requirement.

**Note:** Contractual payment received by a Member in an earlier JV shall be reckoned only to the extent of the concerned member's share in that JV for the purpose of satisfying compliance of the above-mentioned financial eligibility criteria in the tender under consideration.

**1.3.20 Participation of Partnership Firms in works tenders:**

**1.3.20.1** The Partnership Firms participating in the tender should be legally valid under the provisions of the Indian Partnership Act.

**1.3.20.2** The partnership firm should have been in existence or should have been formed prior to submission of tender. Partnership firm should have either been registered with the Registrar or the partnership deed should have been notarized prior to date of tender opening as per the Indian Partnership Act.

**1.3.20.3** Separate identity / name should be given to the partnership firm. The partnership firm should have PAN / TAN number in its own name and PAN / TAN number in the name of any of the constituent partners shall not be considered. The valid constituents of the firm shall be called partners.

**1.3.20.4** Once the tender has been submitted, the constitution of the firm shall not normally be allowed to be modified / altered / terminated during the validity of the tender as well as the currency of the contract except when modification becomes inevitable due to succession laws etc., in which case prior permission should be taken from DFCCIL and in any case the minimum eligibility criteria should not get vitiated. The reconstitution of firm in such cases should be followed by a notary certified Supplementary Deed. The approval for change of constitution of the firm, in any case, shall be at the sole discretion of the DFCCIL and the tenderer shall have no claims what-so-ever. Any change in the constitution of Partnership firm after opening of tender shall be with the consent of all partners and with the signatures of all partners as that in the Partnership Deed. Failure to observe this requirement shall render the offer invalid and full EMD shall be forfeited.

If any Partner/s withdraws from the firm after opening of the tender and before the award of the contract, the offer shall be rejected and EMD of the tenderer will be forfeited. If any new partner joins the firm after opening of tender but prior to award of contract, his / her credentials shall not qualify for consideration towards eligibility criteria either individually or in proportion to his share in the previous firm. In case the tenderer fails to inform DFCCIL beforehand about any such changes / modification in the constitution which is inevitable due to succession laws etc. and the contract is awarded to such firm, then it will be considered a breach of the contract conditions liable for determination of the contract under Clause 62 of General Conditions of Contract.

**1.3.20.5** A partner of the firm shall not be permitted to participate either in his individual capacity or as a partner of any other firm in the same tender.

**1.3.20.6** The tender form shall be submitted only in the name of partnership firm. The EMD shall be deposited by partnership firm through e-payment gateway or as mentioned in tender document. The EMD submitted in the name of any individual partner or in the name of authorized partner (s) shall not be considered.

**1.3.20.7** One or more of the partners of the firm or any other person (s) shall be designated as the authorized person (s) on behalf of the firm, who will be authorized by all the partners to act on behalf of the firm through a “Power of Attorney”, specially authorizing him / them to submit & sign the tender, sign the agreement, receive payment, witness measurements, sign measurement books, make correspondences, compromise / settle / relinquish any claim (s) preferred by the firm, sign “No Claim Certificate”, refer all or any dispute to arbitration and to take similar such action in respect of the said tender / contract. Such “Power of Attorney” shall be notarized / registered and submitted along with the tender.

**1.3.20.8** On issue of Letter of Acceptance (LOA) to the partnership firm, all the guarantees like Performance Guarantee, guarantee for various Advances to the Contractor shall be submitted only in the name of the partnership firm and no splitting of guarantees among the partners shall be acceptable.

**1.3.20.9** On issue of Letter of Acceptance (LOA), contract agreement with partnership firm shall be executed in the name of the firm only and not in the name of any individual partner.

**1.3.20.10** In case the Letter of Acceptance (LOA) is issued to a partnership firm, the following undertakings shall be furnished by all the partners through a notarized affidavit, before signing of contract agreement.

(a) **Joint and several liabilities:**

The partners of the firm to which the Letter of Acceptance (LOA) is issued, shall be jointly and severally liable to the DFCCIL for execution of the contract in accordance with General and Special Conditions of the Contract. The partners shall also be liable jointly and severally for the loss, damages caused to the DFCCIL during the course of execution of the contract or due to non-execution of the contract or part thereof.

(b) **Duration of the partnership deed and partnership firm agreement:**

The partnership deed/partnership firm agreement shall normally not be modified/alterd/ terminated during the currency of contract and the maintenance period after the work is completed as contemplated in the conditions of the contract. Any change carried out by partners in the constitution of the firm without permission of DFCCIL, shall constitute a breach of the contract, liable for determination of the contract under Clause 62 of the General Conditions of Contract.

(c) **Governing laws:** The partnership firm agreement shall in all respect be governed by and interpreted in accordance with the Indian laws.

(d) No partner of the firm shall have the right to assign or transfer the interest right or liability in the contract without the written consent of the other partner/s and that of the DFCCIL.

**1.3.20.11** The tenderer shall clearly specify that the tender is submitted on behalf of a partnership firm. The following documents shall be submitted by the partnership firm, with the tender:

- (i) A notarized copy of partnership deed.
- (ii) A notarized or registered copy of Power of Attorney in favour of the individual to tender for the work, sign the agreement etc. and create liability against the firm.
- (iii) An undertaking by all partners of the partnership firm that they are not blacklisted or debarred by Railways/DFCCIL or any other Ministry / Department of the Govt. of India from participation in tenders / contracts as on the date of opening of bids, either in their individual capacity or in any firm in which they were / are partners. Concealment / wrong information in regard to above shall make the contract liable for determination under Clause 62 of the General Conditions of Contract.

**1.3.20.12 Evaluation of eligibility of a partnership firm:**

Technical and financial eligibility of the firm shall be adjudged based on satisfactory fulfillment of the eligibility criteria laid down above.

**1.3.21 Period of Completion**

The entire work is required to be completed in all respects within **09 months (Nine Months)** from the date of issue of the acceptance letter. Time is the essence of contract. The contract or shall be required to maintain steady and regular progress to the satisfaction of the Engineer to ensure that the work will be completed in all respects within the stipulated time.

**1.3.22** If the Tenderer/s deliberately gives any wrong information about credentials / documents in his/their tenders and thereby create(s) circumstances for acceptance of his/their tender, DFCCIL reserves the right to reject such tender at any stage, besides, shall suspend business with such tenderer. **The EMD** of such tenderers shall *also be forfeited*.

### **1.3.23 Quantum of work and materials:**

The indicative schedule of quantities of various items of works is included in **Form Nos –3 & 4** of the tender document.

### **1.3.24 Employer not bound to accept any tender:**

The Employer shall not be bound to accept the lowest or any tenderor to assign any reason for non-acceptance or rejection of a tender. The employer reserves the right to accept any tender in respect of the whole or any portion of the work specified in the tender papers or to reduce the work or to accept any tender for less than the tendered quantities without assigning any reason whatsoever.

### **1.3.25 Schedule of Prices**

The Schedule as given in the Tender Document list out the Schedule of Prices of various items. Based on these, the total tender value has also been worked out.

### **1.3.26 Performance Guarantee:** Refer clause no. 16(4) of GCC-2020 read in spirit of DFCCIL Letter No. HQ-ENWC/CON1(POLICY)/1/2020 dt. 28.12.2020, Railway Letter No. 2020/CE-I/CT/3E/GCC/Policy dt. 20.11.2020 and OM No. F/914/2020-PPD dt. 12.11.2020

### **1.3.27** The tenderer shall furnish information for making payment through ECS/NEFT/RTGS (*Tender Form No. 8 placed at Part III, Chapter-II of the tender document*).

### **1.3.28 Negotiation:**

Should DFCCIL decide to negotiate with a view to bring down the rates, the tenderer called for negotiations should furnish the following form of declaration before commencement of negotiations:

"I..... do declare that in the event of failure of contemplated negotiations relating to Tender No..... dated .....my original tender shall remain open for acceptance on its original terms and conditions,".

### **1.3.29 Site Inspection:**

Tenderers are requested to inspect the site and carry out careful examination to satisfy them as to the nature of work involved and facilities available at the site. They should note carefully all the existing structures and those under construction through other agencies. They should also study the suitability of utilizing the different equipments and the machinery that they intend to use for the execution of the work. The tenderers should also select suitable sites for the purpose of locating their store yard, laboratory, staff quarters etc.

### **1.3.30 No form C & D shall be issued to the contractor for this work.**

### **1.3.31** The rates quoted by the contractor are deemed to be inclusive of site clearance, setting outwork, profile, setting lay out on ground, establishment of reference benchmark(s), installing various signage, taking

spot levels, survey with total station, construction of all safety and protection devices, compulsory use of helmet and safety shoes, and other appropriate safety gadgets by workers, imparting continuous training for all the workers, barriers, preparatory works, construction of clean, hygienic and well ventilated workers housings in sufficient numbers working during monsoon or odd season, working beyond normal hours, working at all depths, height, lead, lift, levels and location etc. and any other unforeseen but essential incidental works required to complete this work. ***Nothing extra shall be payable*** on this account and ***no extension of time*** for completion of work shall be granted on these accounts.

***In the estimated value of tender, GST @ 18% has been taken on the basic value. The basic value is inclusive of all taxes, duties and levies except GST. The % (above/below/at par) rates quoted by the tenderer shall apply on the basic value. The GST as legally leviable and payable by the Bidder under the provisions of applicable law/act shall be paid extra by DFCCIL.***

***Therefore, the Bidders should quote their rates after considering the Input Tax Credits on their input materials and services. Hence, Bidders should ensure that, full benefit of Input Tax Credit (ITC) likely to be availed by them is duly considered while quoting their rates.***

***If any cost implication to DFCCIL is occurred on GST account because of Contractor's default in filing of GST returns such as no GST number, wrong GST number, mismatch of GST number etc., the same shall be recovered from the Contractor's bill or any other pending/future bill.***

**1.3.32 Price Variation Clause (PVC) will not be applicable for this work. Due to any reason, if the contract period extends beyond 12 months, even in that case, Price Variation clause shall not be applicable.**

**1.3.33 No Mobilization or Secured Advance would be paid by DFCCIL for this work.**

**1.3.34 Contract value:**

The contract value shall be inclusive of GST and all other taxes and duties including ESIC, PF, Conditions of Contract contribution & all other statutory taxes and levies (*if any*) applicable to the Contractors/Workers etc (as applicable).

**1.3.35 Taxes, Duties etc.:**

- (i) GSTIN of DFCCIL will be provided to the contractor along with the letter of acceptance (LOA).
- (ii) Payment to the contractor will be subjected to TDS as per rules inforce from time to time. The tax deduction at source (TDS) shall be done as per the provisions of Income Tax Act & GST, as amended from time to time and a certificate to this effect shall be provided to the contractor by the DFCCIL.
- (iii) Contractor shall submit GST compliant tax invoice containing (GSTIN of DFCCIL) and all the particulars as stipulated under invoice rules of GST law. Payment shall be made to the contractor only after submission of GST compliant Tax Invoice.
- (iv) Increase /decrease in rate of existing GST or cess on GST for Works Contract shall be dealt as per para 37 of GCC (Part-1, Chapter-IV of Tender document).



## **PART- I**

### **CHAPTER- IV**

# **GENERAL CONDITIONS OF CONTRACT**



## PART - I

### CHAPTER IV

#### GENERAL CONDITIONS OF CONTRACT

##### DEFINITIONS AND INTERPRETATION

**1. (1) Definition: -** In these General conditions of Contract, the following terms shall have the meaning assigned hereunder except where the context otherwise requires: -

- (a) **“DFCCIL”** shall mean Dedicated Freight Corridor Corporation of India Ltd, a Govt. of India Enterprise (under Ministry of Railways) and a company incorporated under the provisions of the Companies Act, 1956 having its registered office at 5<sup>th</sup> Floor, Supreme Court Metro Station Complex, New Delhi-110001 represented through its Managing Director or CGM/GM (hereinafter referred to as **“DFCCIL”**) which expression shall, unless repugnant to the context, be deemed to include its successors and assigns.
- (b) **“MD/DFCCIL”** shall mean the officer - in-charge of the General Superintendence and Control of the DFCCIL (MD) and shall mean and include their successors, of the successor of DFCCIL (hereinafter referred to as **“MD/DFCCIL”**).
- (c) **“CGM”** shall mean the officer -in-charge of the CGM unit of DFCCIL and shall also include GM(Co) of DFCCIL.
- (d) **“Engineer”** shall mean Dy. CPM/DFCCIL or any other superior official of DFCCIL or PMC appointed by DFCCIL.
- (e) **“Engineer’s Representative”** shall mean the PM/Dy. PM / APM / Sr. Executive/Executive in direct charge of the work and shall include appointed by the DFCCIL and shall mean and include the Engineer’s Representative of the successor DFCCIL.
- (f) **“Contractor”** shall mean the Person / Firm /Co-operative Society or Company whether incorporated or not who enters into the contract with the DFCCIL and shall include their executors, administrators, and successors and permitted assigns.
- (g) **“Contract”** shall mean and include the Agreement of Work Order, the accepted Schedule of Rates or the Schedule or Rates of CPWD modified by the tender percentage for items of works quantified, or not quantified, the Standard General Conditions of Contract, the Special Conditions of Contracts, if any; the Drawing, the Specifications, the Special Specifications, if any and Tender Forms, if any and all other documents included as part of contract.
- (h) **“Works”** shall mean the works to be executed in accordance with the contract.
- (i) **“Specifications”** shall mean the Standard Specifications for Materials & Works referred/mentioned in tender documents or CPWD or as specified by DFCCIL under the authority of the CGM or as amplified, added to or superseded by Special Specifications, if any.
- (j) **“Schedule of rates of DFCCIL”** shall mean rates specified in “Schedules” of the tender document

or Delhi Schedule of Rates (DSR) of CPWD issued by CPWD from time to time.

- (k) **“Drawing”** shall mean the maps, drawings, plans and tracings or prints there of annexed to the contract and shall include any modifications of such drawings and further drawings as may be issued by the Engineer from time to time.
- (l) **“Constructional Plant”** shall mean all appliances or things of whatsoever nature required for the execution, completion or maintenance of the works or temporary works (*as hereinafter defined*) but does not include materials or other things intended to form or forming part of the permanent work.
- (m) **“Temporary Works”** shall mean all temporary works of every kind required for the execution completion and/or maintenance of the works.
- (n) **“Site”** shall mean the lands and other places on, under, in or through which the works are to be carried out and any other lands or places provided by the DFCCIL for the purpose of the contract.
- (o) **“Period of Maintenance”** shall mean the specified period of maintenance from the date of completion of the works, as certified by the Engineer.
- (p) **‘Contractor’s authorized Engineer’** shall mean a graduate Engineer or equivalent, having experience in the relevant field of construction work involved in the contract, duly approved by Engineer.
- (q) Date of inviting tender shall be the date of publishing tender notice on Tender Wizard/IREPS website if tender is published on website or the date of publication in newspaper in case tender is not published on website.

**1. (2) Singular and Plural:** - Words importing the singular number shall also include the plural and vice versa where the context requires.

**1.(3) Headings & marginal headings:** -The headings and marginal headings in these Standard General Conditions are solely for the purpose of facilitating reference and shall not be deemed to be part thereof or be taken into consideration in the interpretation or construction thereof or the contract.

### **GENERAL OBLIGATION**

**2. (1) Execution Co-relation and intent of contract Documents:** -The contract documents shall be signed in triplicate by the DFCCIL and the Contractor. The contract documents are complementary, and what is called for by any-one shall be as binding as if called for by all, the intention of the documents is to include all labour and materials, equipments and transportation necessary for the proper execution of work. Materials or work not covered by or properly inferable from any heading or class of the specifications shall not be supplied by the DFCCIL to the contractors unless distinctly specified in the contract documents. Materials or works described in words which so applied have a well-known technical or trade meaning shall be held to refer to such recognized standards.

**2.(2)** If a work is transferred from one CGM unit to another CGM or vice versa while contract is in subsistence, the contract shall be binding on the Contractor and the Successor CGM unit in the same

manner & take effect all respects as if the Contractor and the Successor CGM unit were parties there to from the inception and the corresponding officer or the Competent Authority in the Successor CGM unit will exercise the same powers and enjoy the same authority as conferred to the Predecessor CGM unit under the original contract/agreement entered into.

- 2.(3)** If for administrative or other reasons, the contract is transferred to the Successor CGM unit of DFCCIL, the contract shall notwithstanding any things contained herein contrary there to, be binding on the Contractor and the Successor CGM unit of DFCCIL in the same manner and take effect in all respects as if the Contractor and the Successor CGM unit of DFCCIL had been parties thereto from the date of this contract.
- 3.(1) Law governing the contract:** -The contract shall be governed by the law for the time being in force in the Republic of India.
- 3.(2) Compliance to regulations and bye-laws:-**The contractor shall conform to the provision of any statute relating to the works and regulations and bye-laws of any local authority and of any water and lighting companies or undertakings, with whose system the work is proposed to be connected and shall before making any variation from the drawings or the specifications that may be necessitated by so confirming give to the Engineer notice specifying the variation proposed to be made and the reasons for making the variation and shall not carry out such variation until he has received instructions from the Engineer in respect thereof. The contractor shall be bound to give all notices required by statute, regulations or bye-laws as aforesaid and to pay all fees and taxes payable to any authority in respect thereof.
- 4. Communications to be in writing:** - All notices, communications, reference and complaints made by the DFCCIL or the Engineer or the Engineer's representative or the contractor inter-se concerning the work shall be in writing or e-mail on registered e-mail ID's and no notice, communication, reference or complaint not in writing or through e-mail, shall be recognized.
- 5. Service of Notices on Contractors:-**The contractor shall furnish to the Engineer the name designation and address of his authorized agent and all complaints, notices, communications and references shall be deemed to have been duly given to the contractor if delivered to the contractor or his authorized agent or left at or posted to the address so given and shall be deemed to have been so given in the case of posting on day on which they would have reached such address in the ordinary course of post or on the day on which they were so delivered or left. In the case of contract by partners, any change in the constitution of the firm shall be forthwith notified by the contractor to the Engineer.
- 6. Occupation and use of land:** - No land belonging to or in the possession of the DFCCIL shall be occupied by the Contractor without the permission of the DFCCIL. The Contractor shall not use, or allow to be used; the site for any purposes other than that of executing the works. Whenever non-railway bodies/persons are permitted to use DFCCIL premises with competent authority's approval, conservancy charges as applicable from time to time may be levied.
- 7. Assignment or Subletting of Contract:** The Contractor shall not assign or sublet the contract or any part thereof or allow any person to become interested therein in any manner whatsoever without the special permission in writing of the Chief Engineer, save as provided below. Any breach of this condition shall

entitle the Railway to rescind the contract under Clause 62 of these Conditions and also render the Contractor liable for payment to the Railway in respect of any loss or damage arising or ensuing from such cancellation: provided always that execution of the details of the work by petty Contractor under the direct and personal supervision of the Contractor or his agent shall not be deemed to be sub-letting under this clause.

In case Contractor intends to subcontract part of work, he shall submit a proposal in writing seeking permission of Chief Engineer for the same. While submitting the proposal to railway, Contractor shall ensure the following:

(a) (i) Total value of work to be assigned to sub-contractor(s) shall not be more than 50% of total contract value.

(ii) The subcontractor shall have successfully completed at least one work similar to work proposed for subcontract, costing not less than 35% value of work to be subletted, in last 5 years through a works contract. For fulfilment of above, Work Experience Certificate issued by a Govt. Department/Organisation shall be considered. Further, Work Experience Certificate issued by a Public listed company shall be considered provided the company is having average annual turnover of Rs 500 crore and above in last 3 financial years excluding the current financial year, listed on National Stock Exchange or Bombay Stock Exchange, registered at least 5 years back from the date of submission of proposal by Contractor to Railway and work experience certificate issued by a person authorised by the Public Listed Company to issue such certificates. Note: For subletting of work costing up to Rs 50 lakh no previous work experience shall be asked for by the Railway.

In case contractor submits subcontractor's work experience certificate issued by public listed company, the contractor shall also submit along with work experience certificate, the relevant copy of work order, bill of quantities, bill wise details of payment received duly certified by Chartered Accountant, TDS certificates for all payments received and copy of final/last bill paid by company in support of above work experience certificate.

(iii) There is no banning of business with the sub-contractor in force over IR.

- (b) The Contractor shall provide to the Engineer a copy of the agreement to be entered into by Contractor with subcontractor. No subcontractor shall be permitted without a formal agreement between Contractor and subcontractor. This agreement shall clearly define the scope of work to be carried out by subcontractor and the terms of payment in clear & unambiguous manner.
- (c) On receipt of approval from Chief Engineer, Contractor shall enter into a formal agreement legally enforceable in Court of Law with subcontractor and submit a copy of the same to the Engineer.
- (d) The Contractor shall intimate to the Engineer not less than 7 days in advance, the intended date of commencement of subcontractor's work.
- (e) Once having entered into above arrangement, Contractor shall discontinue such arrangement, if he intends to do so at his own or on the instructions of Railway, with prior intimation to Chief Engineer.
- (f) The Contractor shall indemnify railway against any claim of subcontractor.
- (g) The Contractor shall endeavour to resolve all matters and payments amicably and speedily with the subcontractor.
- (h) In addition to issuance of work experience certificate to Contractor, the Engineer, when, based on documents, is satisfied that subcontracted work has been carried out by subcontractor, shall issue work experience certificate to the subcontractor also for the portion of work subcontracted and successfully completed by the sub-contractor. Note: Work Experience Certificate to the subcontractor shall be issued only when the contractor's work is complete and contractor is entitled for the issuance

of Work Experience Certificate. However, in the same contract, when the Chief Engineer, based on documents, is satisfied that the subcontractor has successfully carried out subletted work, without issuance of work experience certificate to subcontractor at this stage, the Chief Engineer can, **only once**, consider the successfully completed subletted work for the fulfilment of eligibility for further subletting of work to the subcontractor in the same contract. When the contractor's work is complete and contractor is entitled for the issuance of work experience certificate, the subcontractor shall be issued one Work Experience Certificate for the total scope of work executed by the subcontractor in the contract.

- (i) The responsibility of successful completion of work by subcontractor shall lie with Contractor. Subcontracting will in no way relieve the Contractor to execute the work as per terms of the Contract.
- (j) Further, in case Engineer is of the view that subcontractor's performance is not satisfactory, he may instruct the Contractor to remove the subcontractor from the work and Contractor has to comply with the above instructions with due promptness. Contractor shall intimate the actual date of discontinuation of subcontract to Engineer. No claim of Contractor whatsoever on this account shall be entertained by the Railway and this shall be deemed as 'excepted matter' (matter not arbitrable).
- (k) The permitted subcontracting of work by the Contractor shall not establish any contractual relationship between the sub-contractor and the Railway and shall not relieve the Contractor of any responsibility under the Contract.

8. **Assistance by the DFCCIL for the Stores to be obtained by the Contractor:** - Owing to difficulty in obtaining certain materials (including Tools & Plant) in the market, the DFCCIL may have agreed without any liability therefore to endeavour to obtain or assist the contractor in obtaining the required quantities of such materials as may be specified in the tender. In the event of delay or failure in obtaining the required quantities of the aforesaid material the contractor shall not be deemed absolved of his own responsibility and shall keep in touch with day to day positions regarding their availability and accordingly adjust progress of works including employment of labour and the DFCCIL shall not in any way be liable for the supply of materials or for the non-supply thereof for any reasons whatsoever nor for any loss or damage arising in consequence of such delay or non-supply.

9. **Deleted**

10. **Deleted**

11. **Deleted**

12. **Representation on Works:-** The contractor shall, when he is not personally present on the site of the works place and keep a responsible agent at the works during working hours who shall on receiving reasonable notice, present himself to the Engineer and orders given by the Engineer or the Engineer's representative to the agent shall be deemed to have the same force as if they had been given to the Contractor. Before absenting himself, the contractor shall furnish the name and address of his agent for the purpose of this clause and failure on the part of the Contractor to comply with this provision at any time will entitle the DFCCIL to **rescind the contract** under clause 62 of these conditions.

13. **Relics and Treasures:-** All gold, silver, oil, other minerals of any description, all precious stones, coins, treasures relics antiquities and other similar things which shall be found in or upon the site shall be the property of the DFCCIL and the Contractor shall duly preserve the same to the

satisfaction of the DFCCIL and shall from time to time deliver the same to such person or persons as the DFCCIL may appoint to receive the same.

- 14. Excavated material:-**The contractor shall not sell or otherwise dispose of or remove except for the purpose of this contract, the sand, stones, clay, ballast, earth, trees, rock or other substances or materials which may be obtained from any excavation made for the purpose of the works or any building or produced upon the site at the time of delivery of the possession thereof but all the substances, materials, buildings and produce shall be the property of the DFCCIL provided that the contractor may, with the permission of the Engineer, use the same for the purpose of the works either free of cost or pay the cost of the same at such rates as may be determined by the Engineer.
- 15. Indemnity by Contractors:** The Contractor shall indemnify and save harmless the DFCCIL from and against all actions, suit, proceedings, losses, costs, damages, charges, claims and demands of every nature and description brought or recovered against the DFCCIL by reason of any act or omission of the contractor, his agents or employees, in the execution of the works or in his guarding of the same. All sums payable by way of compensation under any of these conditions shall be considered as reasonable compensation to be applied to the actual loss or damage sustained, and whether or not any damage shall have been sustained.
- 16.(1) Security Deposit:** - The Earnest Money deposited by the Contractor with his tender will be retained by the DFCCIL as part of security for the due and faithful fulfillment of the contract by the Contractor. The Security Deposit shall be 5% of the contract value. Security Deposit may be deposited by the Contractor before release of first on account bill in cash or Term Deposit Receipt issued from Scheduled Bank, or may be recovered at the rate of 6% of the bill amount till the full Security Deposit is recovered. Provided also that in case of defaulting Contractor, the DFCCIL may retain any amount due for payment to the Contractor on the pending "on account bills" so that the amounts so retained (including amount guaranteed through Performance Guarantee) may not exceed 8% of the total value of the contract.
- Further, in case of contracts having value equal to or more than ₹ 50 crore (Rs Fifty crore) the Security Deposit may be deposited as Bank Guarantee Bond also, issued by a scheduled bank after execution of contract documents, but before payment of 1st on account bill. Provided further that the validity of Bank Guarantee Bond shall be extended from time to time, depending upon extension of contract granted in terms of Clause 17 of the Standard General Conditions of Contract.
- Further, in case Security Deposit has been submitted as Term Deposit Receipt/Bank Guarantee Bond in full amount, the Earnest Money deposited by the Contractor with his tender will be returned by the DFCCIL.
- Note: After the work is physically completed as certified by competent authority, Security Deposit recovered from the running bills of a Contractor can be returned to him, if he so desires, in lieu of Term Deposit Receipt/irrevocable Bank Guarantee for equivalent amount from Scheduled Bank, to be submitted by him.

- 16.(2)(i) Refund of Security Deposit:** Security Deposit mentioned in sub clause (1) above shall be returned to the Contractor along with or after, the following:



- (a) Final Payment of the Contract as per clause 51. (1) **and**
- (b) Execution of Final Supplementary Agreement or Certification by EngineerL that DFCCIL has No Claim on Contractor **and**
- (c) Maintenance Certificate issued, on expiry of the Defect Liability Period (DLP) period as per clause 50. (1), in case applicable.

**16.(2)(ii)** Forfeiture of Security Deposit: Whenever the contract is rescinded as a whole under clause 62 (1) of GCC, the Security Deposit already with DFCCIL under the contract shall be forfeited. However, in case the contract is rescinded in part or parts under clause 62 (1) of GCC, the Security Deposit shall not be forfeited.

**16.(3)** No interest shall be payable upon the Earnest Money and Security Deposit or amounts payable to the Contractor under the Contract, but Government Securities deposited in terms of Sub-Clause 16. (4)(b) of this clause will be payable with interest accrued thereon.

#### **16.(4) Performance Guarantee**

The procedure for obtaining Performance Guarantee is outlined below:

- (a) The successful bidder shall have to submit a Performance Guarantee (PG) within 21 (Twenty-one) days from the date of issue of Letter of Acceptance (LOA). Extension of time for submission of PG beyond 21 (Twenty-one) days and upto 60 days from the date of issue of LOA may be given by the Authority who is competent to sign the contract agreement. However, a penal interest of 12% per annum shall be charged for the delay beyond 21(Twenty-one) days, i.e. from 22nd day after the date of issue of LOA. Further, if the 60th day happens to be a declared holiday in the concerned office of the DFCCIL, submission of PG can be accepted on the next working day.

In all other cases, if the Contractor fails to submit the requisite PG even after 60 days from the date of issue of LOA, the contract is liable to be terminated. In case contract is terminated DFCCIL shall be entitled to forfeit Earnest Money Deposit and other dues payable against that contract. In case a tenderer has not submitted Earnest Money Deposit on the strength of their registration as a Startup recognized by Department of Industrial Policy and Promotion (DIPP) under Ministry of Commerce and Industry, DIPP shall be informed to this effect.

The failed Contractor shall be debarred from participating in re-tender for that work.

- (b) **The successful bidder shall submit the Performance Guarantee (PG) in the form of Irrevocable Bank Guarantee amounting to 3% of the Contract value.**
- (c) The Performance Guarantee shall be submitted by the successful bidder after the Letter of Acceptance (LOA) has been issued, but before signing of the contract agreement. This P.G. shall be initially valid upto the stipulated date of completion plus 60 days beyond that. In case, the time for completion of work gets extended, the Contractor shall get the validity of P.G. extended to cover such extended time for completion of work plus 60 days.
- (d) The value of PG to be submitted by the Contractor will not change for variation upto 25% (either increase or decrease). In case during the course of execution, value of the contract increases by more than 25% of the original contract value, an additional Performance Guarantee amounting to 5% (five

percent) for the excess value over the original contract value shall be deposited by the Contractor. On the other hand, if the value of contract decreases by more than 25% of the original contract value, Performance Guarantee amounting to 5% (five percent) of the decrease in the contract value shall be returned to the Contractor. The PG amount in excess of required PG for decreased contract value, available with DFCCIL, shall be returned to Contractor as per his request duly safeguarding the interest of DFCCIL.

- (e) The Performance Guarantee (PG) shall be released after physical completion of the work based on 'Completion Certificate' issued by the competent authority stating that the Contractor has completed the work in all respects satisfactorily.
- (f) Whenever the contract is rescinded, the Performance Guarantee already submitted for the contract shall be encashed in addition to forfeiture of Security Deposit available with DFCCIL.
- (g) The Engineer/DFCCIL shall not make a claim under the Performance Guarantee except for amounts to which the President of India/DFCCIL is entitled under the contract (not withstanding and/or without prejudice to any other provisions in the contract agreement) in the event of:
  - (i) Failure by the Contractor to extend the validity of the Performance Guarantee as described herein above, in which event the Engineer/DFCCIL may claim the full amount of the Performance Guarantee.
  - (ii) Failure by the Contractor to pay President of India/DFCCIL any amount due, either as agreed by the Contractor or determined under any of the Clauses/Conditions of the Agreement, within 30 days of the service of notice to this effect by Engineer/DFCCIL.
  - (iii) The Contract being determined or rescinded under clause 62 of the GCC.
- (h) **Deleted.**

**17. Force Majeure Clause:-** If at any time, during the continuance of this contract, the performance in whole or in part by either party of any obligation under this contract shall be prevented or delayed by reason of any war, hostility, acts of public enemy, civil commotion, sabotage, serious loss or damage by fire, explosions, epidemics/pandemics, strikes, lockouts or acts of God (hereinafter, referred to events) provided, notice of the happening of any such event is given by either party to the other within 30 days from the date of occurrence thereof, neither party shall by reason of such event, be entitled to terminate this contract nor shall either party have any claim for damages against the other in respect of such non-performance or delay in performance, and works under the contract shall be resumed as soon as practicable after such event has come to an end or ceased to exist, and the decision of the Engineer as to whether the works have been so resumed or not shall be final and conclusive, PROVIDED FURTHER that if the performance in whole or in part of any obligation under this contract is prevented or delayed by reason of any such event for a period exceeding 120 days, either party may at its option terminate the contract by giving notice to the other party.

**17-A Extension of time in Contracts:-** Subject to any requirement in the contract as to completion of any portion or portions of the works before completion of the whole, the Contractor shall fully and finally complete the whole of the works comprised in the contract (with such modifications as may be directed under conditions of this contract) by the date entered in the contract or extended date in terms of the following clauses:

- (i) **Extension due to modification:-** If any modifications have been ordered which in the opinion of the Engineer have materially increased the magnitude of the work, then such extension of the

contracted date of completion may be granted as shall appear to the Engineer to be reasonable in the circumstances, provided moreover that the Contractor shall be responsible for requesting such extension of the date as may be considered necessary as soon as the cause thereof shall arise and in any case not less than one month before the expiry of the date fixed for completion of the works.

- (ii) **Extension for Delay not due to DFCCIL or Contractor:** If in the opinion of the Engineer, the progress of work has any time been delayed by any act or neglect of DFCCIL's employees or by other contractor employed by the DFCCIL under Sub-Clause (4) of Clause 20 of these Conditions or in executing the work not forming part of the contract but on which Contractor's performance necessarily depends or by reason of proceeding taken or threatened by or dispute with adjoining or to neighbouring owners or public authority arising otherwise through the Contractor's own default etc. or by the delay authorized by the Engineer pending arbitration or in consequences of the Contractor not having received in due time necessary instructions from the DFCCIL for which he shall have specially applied in writing to the Engineer or his authorized representative then upon happening of any such event causing delay, the Contractor shall immediately give notice thereof in writing to the Engineer within 15 days of such happening, but shall nevertheless make constantly his best endeavours to bring down or make good the delay and shall do all that may be reasonably required of him to the satisfaction of the Engineer to proceed with the works. The Contractor may also indicate the period for which the work is likely to be delayed and shall be bound to ask for necessary extension of time. The Engineer on receipt of such request from the Contractor shall consider the same and shall grant such extension of time as in his opinion is reasonable having regard to the nature and period of delay and the type and quantum of work affected thereby. No other compensation shall be payable for works so carried forward to the extended period of time; the same rates, terms and conditions of contract being applicable as if such extended period of time was originally provided in the original contract itself.
- (iii) **Extension for Delay due to DFCCIL:** In the event of any failure or delay by the DFCCIL to hand over the Contractor possession of the lands necessary for the execution of the works or to give the necessary notice to commence the works or to provide the necessary drawings or instructions or any other delay caused by the DFCCIL due to any other cause whatsoever, then such failure or delay shall in no way affect or vitiate the contract or alter the character thereof or entitle the Contractor to damages or compensation therefor, but in any such case, the DFCCIL may grant such extension or extensions of the completion date as may be considered reasonable.

**17-B Extension of Time with Liquidated Damages (LD) for delay due to Contractor:** The time for the execution of the work or part of the works specified in the contract documents shall be deemed to be the essence of the contract and the works must be completed not later than the date(s) as specified in the contract. If the Contractor fails to complete the works within the time as specified in the contract for the reasons other than the reasons specified in Clause 17 and 17-A, the DFCCIL may, if satisfied that the works can be completed by the Contractor within reasonable short time thereafter, allow the Contractor for further extension of time (**Proforma at Form-14**) as the Engineer may decide. On such extension the DFCCIL will be entitled without prejudice to any other right and remedy available on that behalf, to recover from the Contractor as agreed damages and not by way of penalty for each week or part of the week, a sum calculated at the following rates of the contract value of the works.

For the purpose of this Clause, the contract value of the works shall be taken as value of work as per contract agreement including any supplementary work order/contract agreement issued. Provided also, that the total amount of liquidated damages under this condition shall not exceed 5% of the contract value or of the total value of the item or groups of items of work for which a

separate distinct completion period is specified in the contract.

SN	Duration of extension of time under Clause 17-B	Rate of Liquidated Damages
(i)	Up to Twenty percent of original period of completion including period of extension of DOC granted under Section 17A(i)	As decided by Engineer, between 0.01% to 0.10% of contract value for each week or part of the week
(ii)	Above Twenty percent but upto Thirty percent of original period of completion including period of extension of DOC granted under Section 17A(i)	0.20% of contract value for each week or part of the week
(iii)	Above Thirty percent but upto Forty percent of original period of completion including period of extension of DOC granted under Section 17A(i)	0.30% of contract value for each week or part of the week
(iv)	Above Forty percent of original period of completion including period of extension of DOC granted under Section 17A(i)	0.50% of contract value for each week or part of the week

Provided further, that if the DFCCIL is not satisfied that the works can be completed by the Contractor and in the event of failure on the part of the contractor to complete the work within further extension of time allowed as aforesaid, the DFCCIL shall be entitled without prejudice to any other right or remedy available in that behalf, to appropriate the contractor's Security Deposit and rescind the contract under Clause 62 of these Conditions, whether or not actual damage is caused by such default.

#### 17-C Deleted

- 18.(1) Illegal Gratification:-** Any bribe, commission, gift or advantage given, promised or offered by or on behalf to the contractor or his partner, agent or servant or, anyone on his behalf, to any officer or employee of the DFCCIL, or to any person on his behalf in relation to obtaining or execution of this or any other contract with the DFCCIL shall, in addition to any criminal liability which he may incur, subject contractor to the **rescission of the contract** and all other contracts with the DFCCIL and to the payment of any loss or damage resulting from such decision and the DFCCIL shall be entitled to deduct the amounts so payable from the Contractor(s)/bills/security deposite or any other dues of contractor with Government of India/DFCCIL.
- 18.(2)** The contractor shall not lend or borrow from or have or enter into any monitory dealings and transactions either directly or indirectly with any employee of the DFCCIL and if he shall do so, the DFCCIL shall be entitled forthwith to **rescind the contract** and all other contracts with the DFCCIL. Any question or dispute as to the commission or any such offence or compensation payable to the DFCCIL under this clause shall be settled by the Chief General Manager/Noida of the DFCCIL, in such a manner as he shall consider fit and sufficient and his decision shall be final and conclusive. In the event of rescission of the contract under this clause, the contractor will not be paid any compensation whatsoever except payments for the work done up to the date of rescission.

### **EXECUTION OF WORKS**

- 19.(1) Contractor's understanding:-** It is understood and agreed that the contractor has, by careful examination, satisfied himself as to the nature and location of the work, the conformation of the ground, the character, quality and quantity of the materials to be encountered, the character of

equipment and facilities needed preliminary to and during the progress of the works, the general and local conditions, the labour conditions prevailing therein and all other matters which can in any way affect the works under the contract.

- 19.(2) Commencement of works:** -The contractor shall commence the works within 15 days after the receipt by him of an order in writing to this effect from the Engineer and shall proceed with the same with due expedition and without delay.
- 19.(3) Accepted Programme of work:-** The contractor who has been awarded the work shall as soon as possible but not later than 30 days after the date of receipt of the acceptance letter in respect of contracts with initial completion period of two years or less or not later than 90 days for other contracts have to submit the detailed programme of work indicating the time schedule of various items of works in the form of Bar Chart/CPM. He shall also submit the details of organization (*in terms of labour and supervisors*) plant and machinery, that he intends to utilize (*from time to time*) for execution of the work within stipulated date of completion. The programme of work amended as necessary by discussions with the Engineer, shall be treated as the agreed programme of the work for the purpose of this contract and the contractor shall endeavour to fulfil this programme of work. The progress of work will be watched accordingly and the ***liquidated damages will be with reference to the overall completion date***. Nothing stated herein shall preclude the contractor in achieving earlier completion of item or whole of the works than indicated in the programme.
- 19.(4) Setting out of works:** - The contractor shall be responsible for the correct setting out of all works in relation to original points, lines and levels of reference at his cost. The contractor shall execute the work true to alignment, grade, levels and dimensions as shown in the drawing and as directed by the Engineer's representative and shall check these at frequent intervals. The contractor shall provide all facilities like labour and instruments and shall co-operate with the Engineer's representative to check all alignment, grades, levels and dimensions. If, at any time, during the progress of the works any error shall appear or arise in any part of the work, the contractor, on being required so to do by the Engineer's representative shall, at his own cost rectify such errors, to the satisfaction of the Engineer's representative.

Such checking shall not absolve the contractor of his own responsibility of maintaining accuracy in the work. The contractor shall carefully protect and preserve all bench marks, sight rails, pegs and other things used in setting out the work.

- 20.(1) Compliance to Engineer's instructions:-**The Engineer shall direct the order in which the several parts of the works shall be executed and the contractor shall execute without delay all orders given by the Engineer from time to time but the contractor shall not be relieved thereby from responsibility for the due performance of the works in all respects.
- 20.(2) Alterations to be authorized:** -No alterations in or additions to or omissions or abandonment of any part of the works shall be deemed authorized, except under instructions from the Engineer. The contractor shall be responsible to obtain such instructions in each and every case in writing from the Engineer.
- 20.(3) Extra works:** - Should works over and above those included in the contract require to be executed at the site, the contractor shall have no right to be entrusted with the execution of such works which may

be carried out by another contractor or contractors or by other means at the option of the DFCCIL.

- 20.(4) Separate contracts in connection with works:** - The DFCCIL shall have the right to let other contracts in connection with the works. The contractor shall afford other contractors' reasonable opportunity for the storage of their materials and the execution of their works and shall properly connect and coordinate his work with theirs. If any part of the contractor's work depends for proper execution or result upon the work of another contractor(s), the contractor shall inspect and promptly report to the Engineer any defects in such works that render it unsuitable for such proper execution and results. The contractor's failure so-to inspect and report shall constitute an acceptance of the other contractor's work as fit and proper for the reception of his work, except as to defects which may develop in the other contractor's work after the execution of his work.
- 21. Instruction of Engineer's Representative:** - Any instructions or approval given by the Engineer's/DFCCIL's representative to contractor in connection with the works shall bind the contractor as though it had been given by the Engineer provided always as follows.
- (a) Failure of the Engineer's representative to disapprove any work or materials shall not prejudice, the power of the Engineer thereafter to disapprove such work or material and to order the removal or breaking up thereof.
  - (b) If the Contractor shall be dissatisfied by reason of any decision of the Engineer's representative, he shall be entitled to refer the matter to the Engineer who shall there upon confirm or vary such decision.
- 22.(1) Adherence to specifications and drawings:** - The whole of the works shall be executed in perfect conformity with the specifications and drawings of the contract. If contractor performs any works in a manner contrary to the specifications or drawings or any of them and without such reference to the Engineer, he shall bear all the costs arising or ensuing therefore and shall be responsible for all loss to the DFCCIL.
- 22.(2) Drawings and specifications of the works:** - The contractor shall keep one copy of drawings and specifications at the site, in good order, and such contract documents as may be necessary available to the Engineer or the Engineer's representative.
- 22.(3) Ownership of drawings and specifications:** - All drawings and specifications and copies thereof furnished by the DFCCIL to the Contractor are deemed to be the property of the DFCCIL. They shall not be used on other works and with the exception of the signed contract set, shall be returned by the contractor to the DFCCIL on completion of the work or termination of the contract.
- 22.(4) Compliance with Contractor's requests for details:** - The Engineer shall furnish with reasonable promptness, after receipt by him of the contractor's request for the same, additional instructions by means of drawings or otherwise, necessary for the proper execution of the works or any part thereof. All such drawing and instructions shall be consistent with the contract Documents and reasonably inferable there from.
- 22.(5) Meaning and intent of specification and drawings:-** If any ambiguity arises as to the meaning and intent of any portion of the specifications and drawings or as to execution or quality of any work or material, or as to the measurements of the works the decision of the Engineer thereon shall be final subject to the appeal (*within 7 days of such decision being*

*intimated to the contractor*) to the CGM who shall have the power to correct any errors, omissions, or discrepancies in aforementioned items and whose decision in the matter in dispute or doubt shall be final and conclusive.

- 23 Working during night:** - The contractor shall not carry out any work between sun-set and sun-rise without the previous permission of the Engineer. However, if the Engineer is satisfied that the work is not likely to be completed in time except by resorting to night work, he may order the same without confirming any right on the Contractor for claiming any extra payment for the same.
- 24. Damage to DFCCIL property or private life and property:-**The contractor shall be responsible for all risk to the work and for trespass and shall make good at his own expense all loss or damage whether to the works themselves or to any other property of the DFCCIL or the lives, persons or property of others from whatsoever cause in connection with the works until they are taken over by the DFCCIL and this although all reasonable and proper precautions may have been taken by the contractor. In case the DFCCIL shall be called upon to make good any costs, loss or damages, or to pay an compensation, including that payable under the provisions of the Workmen's Compensation Act or any statutory amendments thereof to any person or persons sustaining damages as aforesaid by reason of any act, or any negligence or omissions on the part of the contractor the amount of any costs or charges including costs and charges in connection with legal proceedings, which the Railway / DFCCIL may incur in reference thereto, shall be charged to the contractor. The DFCCIL shall have the power and right to pay or to defend or compromise any claim of threatened legal proceedings or in anticipation of legal proceedings being instituted consequent on the action or default of the contractor, to take such steps as may be considered necessary or desirable to ward off or mitigate the effect of such proceedings, charging to contractor, as aforesaid any sum or sums of money which may be paid and any expenses whether for reinstatement or otherwise which may be incurred and the propriety of any such payment, defence or compromise, and the incurring of any such expenses shall not be called in question by the contractor.
- 25. Sheds, Stores houses and Yards:-**The contractor shall at his own expense provide himself with sheds, stores houses and yards in such situations and in such numbers as in the opinion of the Engineer is requisite for carrying on the works and the contractor shall keep at each such sheds, stores houses and yard a sufficient quantity of materials and plant in stock as not to delay the carrying out of the works with due expedition and the Engineer and the Engineer's representative shall have free access to the said sheds, store houses and yards at any time for the purpose of inspecting the stock of materials or plant so kept in hand, and any materials or plan which the Engineer may object to shall not be brought upon or used in the works, but shall be forthwith removed from the sheds, store houses or yards by the contractor. The contractor shall at his own expenses provide and maintain suitable mortar mills, soaking vats or any other equipments necessary for the execution of the works.
- 26. Provision of efficient and competent Staff at work sites by the Contractor: -**
- 26.1** The contractor shall place and keep on the works at all times efficient and competent staff to give the necessary directions to his workmen and to see that they execute their work in sound and proper manner and shall employ only such supervisors, workmen and labourers in or about the execution of any of these works as are careful and skilled in the various trades.

- 26.2** The contractor shall at once remove from the works any agents, permitted sub-contractor, supervisor, workman or labourer who shall be objected to by the Engineer and if and whenever required by the Engineer, he shall submit a correct return showing the names of all staff and workmen employed by him.
- 26.3** In the event of the Engineer being of the opinion that the contractor is not employing on the works a sufficient number of staff and workmen as is necessary for the proper completion of the works within the time prescribed, the contractor shall forthwith on receiving intimation to this effect deploy the additional number of staff and labour specified by the Engineer within seven days of being so required and failure on the part of the contractor to comply with such instructions will entitle the DFCCIL to *rescind the contract* under clause 62 of these conditions.
- 26A. Deployment of Qualified Engineers at Work Sites by the Contractor: -**
- 26A.1** The contractor shall also employ Qualified Graduate Engineer(s) or equivalent, or Qualified Diploma Engineer(s), as per Clause 2.3 of Special Conditions, Section-2 of Part-I Chapter-V OF TENDER DOCUMENT.
- 26A.2** In case qualified Engineer as per clause 26.A.1 is/are absent from site for more than a week period in a month when work is in progress of relevant discipline, then deduction on account of non providing qualified Engg. will be done on pro-rata basis for whole absentee period.
- 26A.3** Deleted
- 27.(1) Workmanship and testing:-** The whole of the works and / or supply of materials specified and provided in the contract or that may be necessary to be done in order to form and complete any part thereof shall be executed in the best and most substantial workman like manner with materials of the best and most approved quality of their respective kinds, agreeable to the particulars contained in or implied by the specifications and as referred to in and represented by the drawings or in such other additional particulars, instructions and drawings given during the carrying on of the works and to the entire satisfaction of the Engineer according to the instructions and directions which the contractors may from time to time receive from the Engineer. The materials may be subjected to tests by means of such machines, instruments and appliances as the Engineer may direct and wholly at the expense of the contractor.
- 27.(2) Removal of improper work and materials: -** The Engineer or the Engineer's Representative shall be entitled to order from time to time:
- (a) The removal from the site within the time specified in the order of any materials which in his opinion are not in accordance with the specifications or drawings.
  - (b) The substitution of proper and suitable materials, and
  - (c) the removal and proper re-execution, notwithstanding any previous tests thereof or on account payments therefore, of any work which in respect of materials or workmanship; is not in his opinion in accordance with the specifications and in case of default on the part of the contractor in carrying out such order the DFCCIL shall be entitled to **rescind the contract** under clause 62 of these conditions.



- (d) The provision of Construction and Demolition Waste Management Rule 2016 issued by Ministry of Environment Forest and Climate Change dated 29.03.2016 and published in the Gazette of India, Part – II, Section -3, Sub-section (ii) are binding upon the Contractor. Contractor shall implement these provisions at worksites, for which no extra payment will be payable.

- 28. Facilities for inspection:-** The contractor shall afford the Engineer and the Engineer's Representative every facility for entering in and upon every portion of the work at all hours for the purpose of inspection or otherwise and shall provide all labour, materials, planks, ladders, pumps, appliances and things of every kind required for the purpose and the Engineer and the Engineer's Representative shall at all times have free access to every part of the works and to all places at which materials for the works are stored or being prepared.
- 29. Examination of work before covering up:-** The contractor shall give 7 days' notice to the Engineer or the Engineer's representative whenever any work or materials are intended to be covered up in the earth, in bodies or walls or otherwise to be placed beyond the reach of measurements in order that the work may be inspected or that correct dimensions may be taken before being so covered, placed beyond the reach of measurement in default whereof, the same shall at the option of the Engineer or the Engineer's representative be uncovered and measured at the contractor's expense or no allowance shall be made for such work or materials.
- 30. Temporary Works: -** All temporary works necessary for the proper execution of the works shall be provided and maintained by the contractor and subject to the consent of the Engineer shall be removed by him at his expenses when they are no longer required and in such manner as the Engineer shall direct. In the event of failure on the part of the contractor to remove the temporary works, the Engineer will cause them to be removed and cost as increased by supervision and other incidental charges *shall be recovered from the contractor*. If temporary huts are provided by the contractor on the Railway land for labour engaged by him for the execution of works, the contractor shall arrange for handing over vacant possession of the said land after the work is completed; if the contractor's labour refuse to vacate, and have to be evicted by the Railway necessary expenses incurred by the Railway in connection therewith shall be borne by the contractor.
- 31.(1) Contractor to supply water for works: -** Unless otherwise provided in the contract, the contractor shall be responsible for the arrangements to obtain supply of water necessary for the works.
- 31.(2) Deleted**
- 31.(3) Deleted**
- 31.(4)(a) Contractor to arrange supply of Electric power for works: -** Unless otherwise provided in the contract, the contractor shall be responsible for arrangements to obtain supply of electric power for the works.
- 31.(4)(b) Deleted**
- 32. Property in materials and plant: -** The materials and plant brought by the Contractor upon the site or on the land occupied by the Contractor in connection with the works and intended to be used for the execution thereof shall immediately, they are brought upon the site of the said land, be deemed to be

the property of the DFCCIL. Such of them as during the progress of the works are rejected by the Engineer under Clause 25 of these conditions or are declared by him not to be needed for the execution of the works or such as on the grant of the certificate of completion remain unused shall immediately on such rejection, declaration or grant cease to be deemed the property of the DFCCIL and the Contractor may then (*but not before*) remove them from the site or the said land. This clause shall not in any way diminish the liability of the Contractor nor shall the DFCCIL be in any way answerable for any loss or damage which may happen to or in respect of any such materials or plant either by the same being lost, stolen, injured or destroyed by fire, tempest or otherwise.

**33. (1) Deleted**

**33.(2) Deleted**

**34.(1) Precaution during progress of works:-** During the execution of works, unless otherwise specified, the Contractor shall at his own cost provide the materials for and execute all shoring, timbering and strutting works as is necessary for the stability and safety of all structures, excavations and works and shall ensure that no damage, injury or loss is caused or likely to be caused to any person or property.

**34.(2) Roads and Water courses: -** Existing roads or water courses shall not be blocked, cut through, altered, diverted or obstructed in any way by the Contractor, except with the permission of the Engineer. All compensations claimed for any unauthorized closure, cutting through, alterations, diversion or obstruction to such roads or water courses by the Contractor or his agent or his staff shall be recoverable from the Contractor's bill/security deposit or any other dues of contractor with the Government of India or DFCCIL.

**34.(3) Provision of access to premises:-** During progress of work in any street or thoroughfare, the Contractor shall make adequate provision for the passage of traffic, for securing safe access to all premises approached from such street or thoroughfare and for any drainage, water supply or means of lighting which may be interrupted by reasons of the execution of the works and shall react and maintain at his own cost barriers, lights and other safeguards as prescribed by the Engineer, for the regulation of the traffic, and provide watchmen necessary to prevent accidents. The works shall in such cases be executed night and day if, so ordered by the Engineer and with such vigour so that the traffic way be impeded for as short a time as possible.

**34.(4) Safety of Public: -** The Contractor shall be responsible to take all precautions to ensure the safety of the public whether on public or DFCCIL property and shall post such look out men as may in the opinion of the Engineer, be required to comply with regulations appertaining to the work. Contractor shall ensure placement of barricading/partitions at the place of work to ensure safety of habitants of adjacent area, failing which Engineer may advise stoppage of work as per his discretion.

**34.(5) Display Board: -** The contractor shall be responsible for displaying the details of works i.e. name of work, approximate cost, expected date of completion, name and address of the Contractor and address of Engineer on a proper steel Board of size not less than 1m x 1m.

**35. Use of Explosives:** Explosives shall not be used on the works or on the site by the Contractor without the permission of the Engineer and then also only in the manner and to the extent to which such permission is given. Where explosives are required for the works, they shall be stored in a special magazine to be

provided by and at the cost of the Contractor in accordance with the Explosive Rules. The Contractor shall obtain the necessary license for the storage and the use of explosives. All operations in which or for which explosives are employed shall be at the sole risk and responsibility of the Contractor and the Contractor shall indemnify the DFCCIL in respect thereof.

- 36.(1) Suspension of works:-** The Contractor shall on the order of the Engineer, suspend the progress of the works or any part thereof for such time or times and in such manner as the Engineer may consider necessary and shall during such suspension properly protect and secure the work so far as is necessary in the opinion of the Engineer. If such suspension is: -
- (a) Provided for in the contract, or
  - (b) Necessary for the proper execution of the works or by the reason of weather conditions or by some default on the part of the Contractor, and/or
  - (c) Necessary for the safety of the works or any part thereof.
- 36.(2)** The Contractor shall not be entitled to the extra costs, if any, incurred by him during the period of suspension of the works, but in the event of any suspension ordered by the Engineer for reasons other than aforementioned and when each such period of suspensions exceeds 14 days, the contractor shall be entitled to such extension of time for completion of the work as the Engineers may consider proper having regard to the period or periods of such suspensions and to such compensations as the Engineer may consider reasonable in respect of salaries or wages paid by the Contractor to his employees during the periods of such suspension.
- 36.(3) Suspension lasting more than 3 months:-** If the progress of the works or any part thereof is suspended on the order of the Engineer for more than three months at a time, the Contractor may serve a written notice on the Engineer requiring permission within 15 days from the receipt thereof to proceed with the works or that part thereof in regard to which progress is suspended and if such permission is not granted within that time the Contractor by further written notice so served may, but is not bound to, elect to treat the suspension where it affects part only of the works as an omission of such part or where it affects the whole of the works, as an abandonment of the contract by the DFCCIL.
- 37. Rates for items of works:-** The rates, entered in the accepted Schedule of Rates of the Contract are intended to provide for works duly and properly completed in accordance with the general and special (if any) conditions of the contract and the specifications and drawings together with such enlargements, extensions, diminutions, reductions, alterations or additions as may be ordered in terms of Clause 42 of these conditions and without prejudice to the generality thereof and shall be deemed to include and cover superintendence and labour, supply, including full freight of materials, stores, patterns, profiles, moulds, fittings, centring, scaffolding, shoring props, timber, machinery, barracks, tackle, roads, pegs, posts, tools and all apparatus and plant required on the works, except such tools, plant or materials as may be specified in the contract to be supplied to the Contractor by the DFCCIL, the erection, maintenance and removal of all temporary works and, buildings, all watching, lighting, bailing, pumping and draining, all prevention of or compensation for trespass, all barriers and arrangements for the safety of the public or of employees during the execution of works, all sanitary and medical arrangements for labour camps as may be prescribed by the DFCCIL, the setting of all work and of the construction, repair and upkeep of all centre lines, bench marks and level pegs thereon,

site clearance, all fees duties, royalties, rent and compensation to owners for surface damage or taxes and impositions payable to local authorities in respect of land, structures and all material supplied for the work or other duties of expenses for which the Contractor may become liable or may be put to under any provision of law for the purpose of or in connection with the execution of the contract, and all such other incidental charges or contingencies as may have been specially provided for in the specifications.

However, if rates of existing GST or cess on GST for Works Contract is increased or any new tax /cess on Works Contract is imposed by Statute after the date of opening of tender but within the original date of completion/date of completion extended under clause 17 & 17A and the Contractor thereupon properly pays such taxes/cess, the Contractor shall be reimbursed the amount so paid.

Further, if rates of existing GST or cess on GST for Works Contract is decreased or any tax/cess on Works Contract is decreased / removed by Statute after the date of opening of tender, the reduction in tax amount shall be recovered from Contractor's bills/Security Deposit or any other dues of Contractor with the Government of India or DFCCIL.

### **38.Deleted**

- 39.(1) Rates for extra items of works:-** Any item of work carried out by the Contractor on the instructions of the Engineer which is not included in the accepted schedules of rates shall be executed at the rates set forth in the "Delhi Schedule of Rates of CPWD" modified by the tender percentage and such items are not contained in the latter, at the rate agreed upon between the Engineer and the Contractor before the execution of such items of work and the Contractors shall be bound to notify the Engineer at least seven days before the necessity arises for the execution of such items of works that the accepted schedule of rates does not include rate or rates for the extra work involved. The rates payable for such items shall be decided at the meeting to be held between the Engineer and Contractor, in as short a period as possible after the need for the special item has come to the notice. In case the Contractor fails to attend the meeting after being notified to do so or in the event of no settlement being arrived at, the DFCCIL shall be entitled to execute the extra works by other means and the Contractor shall have no claim for loss or damage that may result from such procedure.

The assessment of rates for extra items shall be arrived at based on the prevailing rates and by taking guidance from the following documents in order of priority:

- (i) Analysis of Delhi Schedule of Rates issued by CPWD
- (ii) Analysis of Unified Schedule of Rates of Indian Railways
- (iii) Market Analysis

- 39.(2)** Provided that if the Contractor commences work or incurs any expenditure in regard thereto before the rates as determined and agreed upon as lastly hereunto fore-mentioned, then and in such a case the Contractor shall only be entitled to be paid in respect of the work carried out or expenditure incurred by him prior to the date of determination of rates as aforesaid according to the rates as shall be fixed by the Engineer. However, if the Contractor is not satisfied with the decision of the Engineer in this respect, he may appeal to the CGM within 30 days of getting the decision of the Engineer, supported by analysis of the rates claimed. The CGM's decision after hearing both the parties in the matter would be final and binding on the Contractor and the DFCCIL.

- 40. (1) Handing over of works:** - The Contractor shall be bound to hand over the works executed under the contract to the DFCCIL complete in all respects to the satisfaction of the Engineer. The Engineer shall determine the date on which the work is considered to have been completed, in support of which his certificate shall be regarded as sufficient evidence for all purposes. The Engineer shall determine from time to time, the date on which any particular section of the work shall have been completed, and the contractor shall be bound to observe any such determination of the Engineer.
- 40.(2) Clearance of site on completion:** - On completion of works, the Contractor shall clear away and remove from the site all constructional plant, surplus materials, rubbish and temporary works of every kind and leave the whole of the site and works clean and in a workman like condition to the satisfaction of the Engineer. No final payment in settlement of the accounts for the works shall be paid, held to be due or shall be made to the, Contractor till, in addition to any other condition necessary for final payment, site clearance shall have been effected by him, and such clearance may be made by the Engineer at the expense of the Contractor in the event of his failure to comply with this provision within 7 days after receiving notice to that effect. Should it become necessary for the Engineer/DFCCIL to have the site cleared at the expenses of the Contractor, the DFCCIL shall not be held liable for any loss or damage to such of the Contractor's property as may be on the site and due to such removal there from which removal may be effected by means of public sales of such materials and property or in such a way as deemed fit and convenient to the Engineer.

**Clause 40A:** At the final stage of completion and commissioning of work, in case the contractor's failure is limited to only some of the works costing not more than 2% of the original contract value, and the Contractor request the Engineer that such works may be offloaded from him and got executed through another agency and additional cost incurred, if any, should be recovered from his dues; the Engineer on being convinced that the anticipated additional cost for such works will not be substantial and can be recovered from the dues of the contractor and that such offloading will help in completion and commissioning of work, may agree to such offloading without any adverse repercussion on the performance guarantee and security deposit of the Contractor. However, the Engineer will not be under any compulsion to agree to such a request. Further, before issuing letter of acceptance to another agency for such work, the Contractor shall be informed of the rates at which the work will be got executed and the Contractor should give his consent to do so and certify that he would have no future claim on this account and that the extra expenditure so incurred, if any, by the Engineer in getting the offloaded work done, shall be recovered from subsequent Bills or any other dues of the Contractor. In case the Contractor fails to give such consent within three working days, the Engineer may treat the same as not acceptable to Contractor and proceed accordingly. In any case, DFCCIL shall deduct 10% of cost of such work or Rs one lakh whichever is lower, from the Contractor's dues as administrative charges for the process of finalizing new agency for such work irrespective of whether or not such work is finally offloaded from Contractor or not.

#### **VARIATIONS IN EXTENT OF CONTRACT**

- 41. Modification to contract to be in writing:** - In the event of any of the provisions of the contract required to be modified after the contract documents have been signed, the modifications shall be made in writing and signed by the DFCCIL and the Contractor and no work shall proceed under such modifications until this has been done. Any verbal or written arrangement abandoning,

modifying, extending, reducing or supplementing the contract or any of the terms thereof shall be deemed conditional and shall not be binding on the DFCCIL unless and until the same is incorporated in a formal instrument and signed by the DFCCIL and the Contractor, and till then the DFCCIL shall have the right to repudiate such arrangements.

**42.(1) Powers of modification to contract:-** The Engineer on behalf of the DFCCIL shall be entitled by order in writing to enlarge or extend, diminish or reduce the works or make any alterations in their design, character position, site, quantities, dimensions or in the method of their execution or in the combination and use of materials for the execution thereof or to order any additional work to be done or any works not to be done and the contractor will not be entitled, to any compensation for any increase/reduction in the quantities of work but will be paid only for the actual amount of work done and for approved materials supplied against a specific order.

**42.(2) (i)** Unless otherwise specified in the contract, the accepted variation in quantity of each individual item of the contract would be up to 25% of the quantity originally contracted, except in case of foundation work.

(ii) The contractor shall be bound to carry out the work at the agreed rates and shall not be entitled to any claim or any compensation whatsoever up to the limit of 25% variation in quantity of individual item of works.

(iii) In case an increase in quantity of an individual item by more than 25% of the agreement quantity is considered unavoidable, then same shall be excuted at following rates:

(a) Quantities operated in excess of 125% but upto 140% of the agreement quantity of the concerned item, shall be paid at 98% of the rate awarded for that item in that particular tender;

(b) Quantities operated in excess of 140% but upto 150% of the agreement quantity of the concerned item shall be paid 96% of the rate awarded for that item in that particular tender;

(c) Variation in quantity of individual items beyond 150% will be avoided and would be permitted only in exceptional unavoidable circumstances and shall be paid at 96% of the rate awarded for that item in that particular tender.

(d) Variation to quantities for Minor value item:

The limit for varying quantities for minor value items shall be 100% (as against 25% prescribed for other items). A minor value item for this purpose is defined as an item whose original agreement value is less than 1% of the total original agreement value.

d. (i) Quantities operated upto and including 100% of the agreement quantity of the concerned minor value item, shall be paid at the rate awarded for that item in that particular tender;

d.(ii) Quantities operated in excess of 100% but upto 200% of the agreement quantity of the concerned minor value item, shall be paid at 98% of the rate awarded for that item in that particular tender;

d.(iii) Variation in quantities of individual minor value item beyond 200% will be avoided and would be permitted only in exceptional unavoidable circumstances and shall be

paid at 96% of the rate awarded for that item in that particular tender.

- (iv) In case of earthwork, the variation limit of 25% shall apply to the gross quantity of earth work and variation in the quantities of individual classifications of soil shall not be subject to this limit.
- (v) In case of foundation work, no variation limit shall apply and the work shall be carried out by the contractor on agreed rates irrespective of any variation.
- (vi) As far as SOR items are concerned, the limit of 25% would apply to the value of SOR schedule as a whole and not on individual SOR items. However, in case of NS items, the limit of 25% would apply on the individual items irrespective of the manner of quoting the rate (single percentage rate or individual item rate).

**42.(3) Valuation of variations:-** The enlargements, extensions, diminution, reduction, alterations or additions referred to in sub-clause (2) of this clause shall in no degree affect the validity of the contract but shall be performed by the Contractor as provided therein and be subject to the same conditions, stipulations and obligations as if they had been originally and expressively included and provided for in the specifications and drawings and the amounts to be paid therefore shall be calculated in accordance with the accepted schedule of rates. Any extra items / quantities of work falling outside the purview of the provisions of sub-clause (2) above shall be paid for at the rates determined under clause-39 of these conditions.

### **CLAIMS**

**43.(1) Quarterly Statement of Claims:** The Contractor shall prepare and furnish to the Engineer/DFCCIL once in every quarter commencing from the month following the month of issue of Letter of Acceptance, an account giving full and detailed particulars of all claims for any additional expenses to which the Contractor may consider himself entitled to and of all extra or additional works ordered by the Engineer which he has executed during the preceding ~~month~~ quarter and no claim for payment for such work will be considered which has not been included in such particulars.

**43.(2) Signing of “No Claim” Certificate:-** The Contractor shall not be entitled to make any claim whatsoever against the DFCCIL under or by virtue of or arising out of this contract, nor shall the DFCCIL entertain or consider any such claim, if made by the Contractor, after he shall have signed a “No Claim” Certificate in favour of the DFCCIL in such form as shall be required by the DFCCIL after the works are finally measured up. The contractor shall be debarred from disputing the correctness of the items covered by “No Claim” Certificate or demanding a clearance to arbitration in respect thereof.

### **MEASUREMENTS, CERTIFICATES AND PAYMENTS**

**44. Quantities in schedule annexed to Contract: -** The quantities set out in the accepted schedule of rates with items of works quantified are the estimated quantities of the works and they shall not be taken as the actual and correct quantities of the work to be executed by the Contractor in fulfilment of his obligations under the contract.

**45.(i) Measurement of works:-** The Contractor shall be paid for the works at the rates in the accepted schedule of rates and for extra works at rates determined under Clause 39 of these conditions on the measurements taken by the Engineer or the Engineer's representative in accordance with the rules prescribed for the purpose by the DFCCIL. The quantities for items the unit of which in the accepted schedule of rates is 100 or 1000 shall be calculated to the nearest whole number, any; fraction below half being dropped and half and above being taken as one; for items the unit of which in the accepted schedule of rates is single, the quantities shall be calculated to two places of decimals. Such measurements will be taken of the work in progress from time to time and at such intervals as in the opinion of the Engineer shall be proper having regard to the progress of works. The date and time on which "on account" or final measurements are to be made shall be communicated to the Contractor who shall be present at the site and shall sign the results of the measurements (which shall also be signed by the Engineer or the Engineer's representative) recorded in the official measurements book as an acknowledgement of his acceptance of the accuracy of the measures. Failing the Contractor's attendance, the work may be measured up in his absence and such measurements shall, notwithstanding such absence, be binding upon the Contractor whether or not he shall have signed the measurement books provided always that any objection made by him to measurement shall be duly investigated and considered in the manner set out below: -

- (a) It shall be open to the Contractor to take specific objection to any recorded measurements or Classification on any ground within seven days of the date of such measurements. Any re-measurement taken by the Engineer or the Engineer's representative in the presence of the Contractor or in his absence after due notice has been given to him in consequence of objection made by the Contractor shall be final and binding on the Contractor and no claim whatsoever shall thereafter be entertained regarding the accuracy and classification of the measurements.
- (b) If an objection raised by the Contractor is found by the Engineer to be incorrect the Contractor shall be liable to pay the actual expenses incurred in measurements.

**45. (ii) Measurement of works by Contractor's Authorized Representative (In case the Contract provides for the same)**

- (a) The Contractor shall be paid for the works at the rates in the accepted Schedule of Rates and for extra works at rates determined under Clause 39 of these Conditions on the measurements taken by the contractor's authorized engineer in accordance with the rules prescribed for the purpose by DFCCIL. The quantities for items the unit of which in the accepted Schedule of Rates is 100 or 1000 shall be calculated to the nearest whole number, any fraction below half being dropped and half above being taken as one; for items the unit of which in the accepted Schedule of Rates is single, the quantity shall be calculated to two places of decimals. Such measurements will be taken of the works in progress from time to time. The date and time on which 'on account or final' measurements are to be made shall be communicated to the Engineer.

Date and time of test checks shall be communicated to the Contractor, who shall be present at the site and shall witness the test checks, failing Contractor's adherence, the test check may be conducted in his absence and such test checks shall not, withstanding such absence be binding upon Contractor provided always that any objections made by Contractor to test check shall be duly investigated and considered in the manner set out below:



- (i) It shall be open to Contractor to take specific objections to test check of any recorded measurements within 7 days of date of such test checks. Any re-test check done by the concerned DFCCIL's Authority in the presence of the Contractor or in his absence after due notice, given to him in consequent of objections made by the Contractor shall be final and binding on the Contractor and no claim whatsoever shall thereafter be entertained regarding the accuracy and classification of the measurements.
  - (ii) If an objection raised by the Contractor is found by the Engineer to be incorrect, the Contractor shall be liable to pay the actual expenses incurred in measurements.
- (b) **Incorrect measurement/action to be taken:** If in case during test check or otherwise, it is detected by the Engineer that Agency has claimed any exaggerated measurement or as claimed any false measurement for the work which have not been executed; amounting to variation of 5% or more of claimed gross bill amount, action shall be taken as following:
- (i) On first occasion of noticing, exaggerated/false measurement, Engineer shall impose a penalty of 10% of claimed gross bill value.
  - (ii) On any next occasion of noticing any exaggerated/false measurement, DFCCIL shall impose penalty of 15% of claimed gross bill value. In addition, the facility of recording of measurement by Contractor as well as release of provisional payment shall be withdrawn. Once withdrawn, measurement shall be done by DFCCIL as per Clause-45(i) above.

**46. (1) "On-Account" Payments:** - The Contractor shall be entitled to be paid from time to time by way of "One-Account" payment only for such works as in the opinion of the Engineer he has executed in terms of the contract. All payments due on the Engineer's representative's certificates of measurements or Engineer's Certified "Contractor's Authorized Engineer's measurements" shall be subject to any deductions which may be made under these presents and shall further be subject to, unless otherwise required by Clause 16 of these conditions, a retention of ten percent by way of security deposits, until the amount of security deposit by way of retained earnest money and such retentions shall amount to 5% of the total value of the contract provided always that the Engineer may by any certificate make any correction or modification in any previous certificate which shall have been issued by him and that the Engineer may withhold any certificate if the works or any part thereof are not being carried out to his satisfaction.

**46.(2) Rounding off amounts:** - The total amount due on each certificate shall be rounded off to the nearest rupee i.e. sum less than 50 paise shall be omitted and sums of 50 paise and more upto Re. 1/- will be reckoned as Re. 1/-.

**46.(3) On Account Payments not prejudicial to final settlement:-** "On- Account" payments made to the Contractor shall be without prejudice to the final making up of the accounts (except where measurements are specifically noted in the Measurement Book as "Final Measurements" and as such have been signed by the Contractor Engineer's/Engineer's Representative) and shall in no respect be considered or used as evidence of any facts stated in or to be inferred from such accounts nor of any particular quantity of work having been executed nor of the manner of its execution being satisfactory.

**46.(4) Manner of payment:** - Unless otherwise specified payments to the Contractor will be transferred electronically to his bank account.

**46A PRICE VARIATION CLAUSE:(Not applicable)**

**46A.1 Deleted**

**46A.2 Deleted**

**46A.3 Deleted**

**46A.4 Deleted**

**46A.5 Deleted**

**46A.6 Deleted**

**46A.7 Deleted**

**46A.8 Deleted**

**46A.9 Deleted**

**46A.10 Deleted**

**47.0 Maintenance of works :-** The Contractor shall at all times during the progress and continuance of the works and also for the period of Defect Liability (**Defect Liability period**) specified in the Tender Form after the date of issue of the certificate of completion by the Engineer or any other earlier date subsequent to the completion of the works that may be fixed by the Engineer be responsible for and effectively maintain and uphold in good substantial, sound and perfect condition all and every part of the works and shall make good from time to time and at all times as often as the Engineer shall require, any damage or defect that may during the above period arise in or be discovered or be in any way connected with the works, provided that such damage or defect is not directly caused by errors in the contract documents, act of providence or insurrection or civil riot, and the contractor shall be liable for and shall pay and make good to the DFCCIL or other persons legally entitled thereto whenever required by the Engineer so to do, all losses, damages, costs and expenses they or any of them may incur or be put or be liable to by reasons or in consequence of the operations of the Contractor or of his failure in any respect.

**48.(1) Certificate of completion of works:-** As soon as in the opinion of the Engineer, the works has been completed and has satisfactorily passed any final test or tests that may be prescribed, the Engineer shall issue a certificate of completion duly indicating the date of completion in respect of the work and the period of maintenance of the work shall commence from the date of completion mentioned in such certificate. The certificate, inter alia, should mention that the work has been completed in all respects and that all the contractual obligations have been fulfilled by the Contractor and that there is no due from the Contractor to DFCCIL against the contract concerned.

The Engineer may also issue such a certificate indicating date of completion with respect to any part of the work (*before the completion of the whole of work*), which has been both completed to the satisfaction of the Engineer and occupied or used by the DFCCIL. When any such certificate is given in respect of

part of a work, such part shall be considered as completed and the period of maintenance of such part shall commence from the date of completion mentioned in the completion certificate issued for that part of the work.

- 48.(2) Contractor not absolved by completion Certificate:-** The Certificate of completion in respect of the works referred to in sub-clause (1) of this clause shall not absolve the Contractor from his liability to make good any defects imperfections, shrinkages or faults which may appear during the period of maintenance specified in the tender arising in the opinion of the Engineer from materials or workmanship not in accordance with the drawings or specifications or instruction of the Engineer, which defects, imperfections, shrinkages or faults shall upon the direction in writing of the Engineer be amended and made good by the Contractor at his own cost: and in case of default on the part of Contractor the Engineer may employ labour and materials or appoint another Contractor to amend and make good such defects, imperfections, shrinkages and faults and all expenses consequent thereon and incidental thereto shall be borne by the Contractor and shall be recoverable from any moneys due to him under the contract.
- 48.(3) Final Supplementary Agreement:** After the work is completed or otherwise concluded by the parties with mutual consent, and taken over by the DFCCIL as per terms and conditions of the contract agreement, and there is unequivocal no claim on either side under the Contract other than as mentioned in item 4 of Form no. 20, the parties shall execute the Final Supplementary Agreement as per **Form No. 20**.
- 49. Approval only by maintenance Certificate:** - No certificate other than maintenance certificate referred to in Clause 50 of the conditions shall be deemed to constitute approval of any work or other matter in respect of which it is issued or shall be taken as an admission of the due performance of the contract or any part thereof.
- 50.(1) Maintenance Certificate:** - The Contract shall not be considered as completed until a Maintenance Certificate shall have been signed by the Engineer stating that the works have been completed, Defect liability Period is over and created asstes are maintained to his satisfaction. The Maintenance Certificate shall be given by the Engineer upon the expiration of the Defect liability Period or as soon thereafter as any works ordered during such period pursuant to sub clause (2) Clause 48 of these conditions shall have been completed to the satisfaction of the Engineer and full effect shall be given to this Clause notwithstanding the taking possession of or using the works or any part thereof by the DFCCIL.
- The Competent Authority to issue above Maintenance Certificate shall normally be the authority who is competent to sign the contract. If this Competent Authority is of the rank lower than Dy.CPM Grade, then a Dy.CPM Grade Officer (concerned with the work) should issue the Certificate. The Certificate, inter alia, should mention that the work has been completed in all respects and that all the contractual obligations have been fulfilled by the Contractor and that there is no due from the Contractor to DFCCIL against the contract concerned.
- 50.(2) Cessation of DFCCIL Liability:** - The DFCCIL shall not be liable to the Contractor for any matter arising out of or in connection with the contract of the execution of the works unless the contractor has made a claim in writing in respect thereof before the issue of the Maintenance Certificate under this clause.

**50.(3) Unfulfilled Obligations:-** Notwithstanding the issue of the Maintenance certificate the Contractor and *(subject to sub-clause 2 of this clause)* the DFCCIL shall remain liable for the fulfilment of any obligation incurred under the provision of the contract prior to the issue of the Maintenance Certificate which remains unperformed at the time such certificate is issued and for the purposes of determining the nature and extent of any such obligations the contract shall be deemed to remain in force between the parties thereto.

**51.(1) Final Payment:-** On the Engineer's certificate of completion in respect of the works, adjustment shall be made and the balance of account based on the Engineer or the Engineer's representative's certified measurements or Engineer's certified "Contractor's Authorized Engineer's measurements" of the total quantity of work executed by the contractor upto the date of completion and on the accepted schedule or rates and for extra works on rates determined under Clause 39 of these conditions shall be paid to the Contractor subject always to any deduction which may be made under these presents and further subject to the Contractor having signed delivered to the Engineer either a full account in detail of all claims he may have on the DFCCIL in respect of the works or having delivered "No Claim Certificate" and the Engineer having after the receipt of such account given a certificate in writing that such claims are not covered under excepted matter i.e. Clauses 7 (j), 8, 18, 22(5), 39, 43(2), 45(i)(a), 55, 55-A(5), 57, 57A, 61(1), 61(2) and 62(1)(i) to (xv) (B) of Standard General Conditions of Contract or in any Clause (stated as excepted matter) of the Special Conditions of the Contract, that the whole of the works to be done under the provisions of the Contracts have been completed, that they have been inspected by him since their completion and found to be in good and substantial order, that all properties, works and things, removed, disturbed or injured in consequence of the works have been properly replaced and made good and all expenses and demands incurred by or made upon the DFCCIL for or in the respect of damage or loss by from or in consequence of the works, have been satisfied agreeably and in conformity with the contract.

**51.(2) Post Payment Audit:-** It is an agreed term of contract that the DFCCIL reserves to itself the right to carry out a post-payment audit and or technical examination of the works and the final bill including all supporting vouchers, abstracts etc. and to make a claim on the contractor for the refund any excess amount paid to him till the release of Security Deposit of settlement of claims, which ever is later, if as a result of such examination any over-payment to him is discovered to have made in respect of any works done or alleged to have been done by him under the contract.

**51A. Production of vouchers etc. by the Contractor: -**

- (i) For a contract of more than one crore of rupees, the contractor shall, whenever required, produce or cause to be produced for examination by the Engineer any quotation, invoice, cost or other account, book of accounts, voucher, receipt, letter, memorandum, paper of writing or any copy of or extract from any such document and also furnish information and returns verified in such manner as may be required in any way relating to the execution of this contract or relevant for verifying or ascertaining cost of execution of this contract (the decision of the engineer on the question of relevancy of any documents, information or return being final and binding in the parties).The contractor shall similarly produce vouchers; etc., if required to prove to the Engineer, that materials supplied by him, are in accordance with the specifications laid down in the contract.

- (ii) If any portion of the work in a contract of value more than one crore of rupees be carried out by a sub-contractor or any subsidiary or allied firm or company (as per Clause 7 of the General Conditions of Contract), the Engineer shall have power to secure the books of such sub-contract or any subsidiary or allied firm or company, through the contractor, and such books shall be open to his inspection.
- (iii) The obligations imposed by sub clause (i) & (ii) above is without prejudice to the obligations of the contractor under any statute rules or orders binding on the contractor.

**52.0 Withholding and lien in respect of sums claimed:-** Whenever any claim or claims for payment of a sum of money arises out of or under the contract against the contractor, the DFCCIL shall be entitled to withhold and also have a lien to retain such sum or sums in whole or in part from the security, if any, deposited by the contractor and for the purpose aforesaid, the DFCCIL shall be entitled to withhold the said cash security deposit or the security if any, furnished as the case may be and also have a lien over the same pending finalization or adjudication of any such claim. In the event of the security being insufficient to cover the claimed amount or amounts or if no security has been taken from the contractor, the DFCCIL shall be entitled to withhold and have a lien to the extent of the such claimed amount or amounts referred to supra, from any sum or sums found payable or which at any time thereafter may become payable to the contractor under the same contract or any other contract with this or any other DFCCIL or any Department of the Central Government pending finalization or adjudication of any such claim.

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

**52A. Lien in respect of claims in Other Contracts: -**

- (i) Any sum of money due and payable to the contractor (including the security deposit returnable to him) under the contract may be withheld or retained by way of lien by the DFCCIL, against any claim of this or any other DFCCIL or any other Department of the Central Government in respect of a payment of a sum of money arising out of or under any other contract made by the contractor with this or any other Department of the Central Government.
- (ii) However, recovery of claims of DFCCIL in regard to terminated contracts may be made from the Final Bills, Security Deposits and Performance Guarantees of other contract or contracts, executed by the contractor. The Performance Guarantees submitted by the Contractor against other contracts, if required, may be withheld and encashed. In addition, 10% of each subsequent 'on-

account bill' may be withheld, if required, for recovery of DFCCIL dues against the terminated contract.

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

**53.0 Signature on Receipts for Amounts:-** Every receipt for money which may become payable or for any security which may become transferable to the Contractors under these presents, shall, if signed in the partnership name by anyone of the partners of a Contractor's firm be a good and sufficient discharge to the DFCCIL in respect of the moneys or security purported to be acknowledged thereby and in the event of death of any of the Contractor, partners during the pendency of the contract it is hereby expressly agreed that every receipt by anyone of the surviving Contractor partners shall if so signed as aforesaid be good a sufficient discharge as aforesaid provided that nothing in this clause contained shall be deemed to prejudice or effect any claim which the DFCCIL may hereafter have against the legal representative of any contractor partner so dying for or in respect to any breach of any of the conditions of the contract, provided also that nothing in this clause contained shall be deemed to prejudice or effect the respective rights or obligations of the Contractor partners and of the legal representatives of any deceased Contractor partners interse.

## **LABOUR**

**54.0 Wages to Labour: -** The Contractor shall be responsible to ensure compliance with the provision of the Minimum Wages Act, 1948 (hereinafter referred to as the "said Act") and the Rules made there under in respect of any employees directly or through petty contractors or subcontractors employed by him for the purpose of carrying out this contract.

If, in compliance with the terms of the contract, the Contractor supplied any labour to be used wholly or partly under the direct orders and control of the DFCCIL whether in connection with any work being executed by the Contractor or otherwise for the purpose of the DFCCIL such labour shall, for the purpose of this clause, still be deemed to be persons employed by the Contractor.

If any moneys shall, as a result of any claim or application made under the said Act be directed to be paid by the DFCCIL, such money shall be deemed to be moneys payable to the DFCCIL by the Contractor and on failure by the Contractor to repay the DFCCIL any moneys paid by it as aforesaid within seven days after the same shall have been demanded, the DFCCIL shall be entitled to recover the same from Contractor's bills/Security Deposit or any other dues of Contractor with the Government of India or DFCCIL.

**54A. Apprentices Act: -** The Contractor shall be responsible to ensure compliance with the provisions of the Apprentices Act, 1961 and the Rules and Orders issued there under from time to time in respect of apprentices directly or through petty contractors or sub-contractors employed by him for the purpose of

carrying out the Contract.

If the contractor directly or through petty contractors or sub-contractors fails to do so, his failure will be a breach of the contract and the DFCCIL may, in its discretion, rescind the contract. The contractor shall also be liable for any pecuniary liability arising on account of any violation of the provisions of the Act.

- 55. Provisions of payments of Wages Act:** - The Contractor shall comply with the provisions of the Payment of Wages Act, 1936 and the rules made there under in respect of all employees employed by him either directly or through petty Contractors or sub-contractors in the works. If in compliance with the terms of the contract, the Contractor directly or through petty Contractors or sub-contractors shall supply any labour to be used wholly or partly under the direct orders and control of the Engineer whether in connection with the works to be executed hereunder or otherwise for the purpose of the Engineer, such labour shall nevertheless be deemed to comprise persons employed by the Contractor and any moneys which may be ordered to be paid by the Engineer shall be deemed to be moneys payable by the Engineer on behalf of the Contractor and the Engineer may on failure of the Contractor to repay such money to the DFCCIL deduct the same from any moneys due to the Contractor in terms of the contract. The DFCCIL shall be entitled to recover the same from Contractor's bills/Security Deposit or any other dues of Contractor with the Government of India or DFCCIL all moneys paid or payable by the DFCCIL by way of compensation of aforesaid or for costs of expenses in connection with any claim thereto and the decision of the Engineer upon any question arising out of the effect or force of this Clause shall be final and binding upon the Contractor.

**55A. Provisions of Contract labour (Regulation and Abolition) Act, 1970:**

- 55A. (1)** The contractor shall comply with the provision of the contract labour (Regulation and Abolition) Act, 1970 and the Contract labour (Regulation and Abolition) Central Rules 1971 as modified from time to time, wherever applicable and shall also indemnify the DFCCIL from and against any claims under the aforesaid Act and the Rules.
- 55A. (2)** The Contractor shall obtain a valid licence under the aforesaid Act as modified from time to time before the commencement of the work and continue to have a valid licence until the completion of the work. Any failure to fulfil the requirement shall attract the penal provision of the Act.
- 55A. (3)** The Contractor shall pay to the labour employed by him directly or through subcontractors the wages as per provision of the aforesaid Act and the Rules wherever applicable. The Contractor shall notwithstanding the provisions of the contract to the contrary, cause to be paid the wages to labour indirectly engaged on the works including any engaged by subcontractors in connection with the said work, as if the labour had been immediately employed by him.
- 55A. (4)** In respect of all labour directly or indirectly employed in the work for performance of the contractor's part of the contract, the Contractor shall comply with or cause to be complied with the provisions of the aforesaid Act and Rules wherever applicable.
- 55A.(5)** In every case in which, by virtue of the provisions of the aforesaid Act or the rules, the DFCCIL is obliged to pay any amount of wages to a workman employed by the Contractor or his sub-contractor in execution of the work or to incur any expenditure on account of the contingent, liability of the

DFCCIL due to the Contractor's failure to fulfill his statutory obligations under the aforesaid Act or the rules, the DFCCIL will recover from the Contractor, the amount of wages so paid or the amount of expenditure so incurred and without prejudice to the rights of the DFCCIL under the Section 20, Sub-Section (2) and Section 2, Sub-Section (4) of the aforesaid Act, the DFCCIL shall be at liberty to recover such amount or part thereof from Contractor's bills/Security Deposit or any other dues of Contractor with the DFCCIL. The DFCCIL shall not be bound to contest any claim made against it under Sub-Section (1) of Section 20 and Sub-Section (4) of Section 21 of the aforesaid Act except on the written request of the Contractor and upon his giving to the DFCCIL full security for all costs for which the DFCCIL might become liable in contesting such claim. The decision of the CGM regarding the amount actually recoverable from the Contractor as stated above shall be final and binding on the Contractor.

**55B. Provisions of Employees Provident Fund and Miscellaneous Provisions Act, 1952:**

The Contractor shall comply with the provisions of Para 30 & 36-B of the Employees Provident Fund Scheme, 1952; Para 3 & 4 of Employees' Pension Scheme, 1995; and Para 7 & 8 of Employees Deposit Linked Insurance Scheme, 1976; as modified from time to time through enactment of "Employees Provident Fund & Miscellaneous Provisions Act, 1952", wherever applicable and shall also indemnify the DFCCIL from and against any claims under the aforesaid Act and the Rules.

**55C.(i)** Contractor is to abide by the provisions of Payment of Wages act & Minimum Wages act in terms of clause 54, 55, 55A and 55B of Indian Railways General Condition of Contract. In order to ensure the same, an application has been developed and hosted on website 'www.shramikkalyan.indianrailways.gov.in'. Contractor shall register his firm/company etc. and upload requisite details of labour and their payment in this portal. These details shall be available in public domain. The Registration/ updation of Portal shall be done as under:

- (a) Contractor shall apply for one-time registration of his company/firm etc. in the Shramikkalyan portal with requisite details subsequent to issue of Letter of Acceptance. Engineer shall approve the contractor's registration in the portal within 7 days of receipt of such request.
  - (b) Contractor once approved by any Engineer, can create password with login ID (PAN No.) for subsequent use of portal for all Letter of Acceptances (LoAs) issued in his favour.
  - (c) The contractor once registered on the portal, shall provide details of his Letter of Acceptances (LoA) / Contract Agreements on shramikkalyan portal within 15 days of issue of any LoA for approval of concerned Engineer. Engineer shall update (if required) and approve the details of LoA filled by contractor within 7 days of receipt of such request.
  - (d) After approval of LoA by Engineer, contractor shall fill the salient details of contract labours engaged in the contract and ensure updating of each wage payment to them on shramikkalyan portal on monthly basis.
  - (e) It shall be mandatory upon the contractor to ensure correct and prompt uploading of all salient details of engaged contractual labour & payments made thereof after each wage period.
- (ii) While processing payment of any 'On Account bill' or 'Final Bill' or release of 'Advances' or 'Performance Guarantee / Security deposit', contractor shall submit a certificate to the Engineer or Engineer's representatives that "I have uploaded the correct details of contract labours engaged in



connection with this contract and payments made to them during the wage period in Railway's Shramikkalyan portal at 'www.shramikkalyan.indianrailways.gov.in' till \_\_\_\_Month, \_\_\_\_Year."

**55-D Provisions of "The Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996" and "The Building and Other Construction Workers' Welfare Cess Act, 1996":**

The tenderers, for carrying out any construction work, shall get themselves registered with the Registering Officer under Section-7 of the Building and Other Construction Workers Act, 1996 and rules made thereto by the concerned State Govt., and submit certificate of Registration issued from the Registering Officer of the concerned State Govt. (Labour Dept.). The Cess shall be deducted from contractor's bills as per provisions of the Act.

**56.0 Reporting of Accidents: -** The Contractor shall be responsible for the safety of all employees directly or through petty contractors or sub- contractor employed by him on the works and shall report serious accidents to any of them however and wherever occurring on the works to the Engineer or the Engineers Representative and shall make every arrangement to render all possible assistance.

**57.0 Provision of Workmen's Compensation Act:-** In every case in which by virtue of the provisions of section 12 sub-section (1) of the Workmen's Compensation Act 1923, DFCCIL is obliged to pay compensation to a workman directly or through petty contractor or subcontractor employed by the Contractor in executing the work, DFCCIL will recover from the Contractor the amount of the compensation so paid, and, without prejudice to the rights of DFCCIL under Section 12 Sub-section (2) of the said Act, DFCCIL shall be at liberty to recover such amount or any part thereof from contractor's bills/Security Deposit or any other dues of Contractor with the Government of India. DFCCIL shall not be bound to contest any claim made against it under Section 12 Sub-section (1) of the said Act except on the written request of the Contractor and upon his giving to DFCCIL full security for all costs for which DFCCIL might become liable in consequence of contesting such claim.

**57A. Provision of Mines Act:-** The contractor shall observe and perform all the provisions of the Mines Act, 1952 or any statutory modifications or re-enactment thereof for the time being in force and any rules and regulations made there under in respect of all the persons directly or through the petty contractors or sub-contractors employed by him under this contract and shall indemnify the DFCCIL from and against any claims under the Mines Act, or the rules and regulations framed there under, by or on behalf of any persons employed by him or otherwise.

**58.0 Railway/DFCCIL not to provide quarters for Contractors: -** No quarters shall normally be provided by the DFCCIL for the accommodation of the contractor or any of his staff employed on the work. In exceptional cases where accommodation is provided to the Contractor at the DFCCIL discretion, recoveries shall be made at such rates as may be fixed by the DFCCIL for the full rent of the buildings and equipments therein as well as charges for electric current, water supply and conservancy.

**59.(1) Labour Camps: -** The contractor shall at his own expense make adequate arrangements for the housing, supply of drinking water and provision of latrines and urinals for his staff and workmen, directly or through the petty contractors or sub-contractors and for temporary crèche (*Bal-mandir*) where 50 or more women are employed at a time. Suitable sites on DFCCIL land, if available, may be allotted to the contractor for the erection of labour camps, either free of charge or on such terms and conditions that may be prescribed by the DFCCIL. All camp sites shall be maintained in clean and

sanitary conditions by the contractor at his own cost.

- 59.(2) Compliance to rules for employment of labour:-** The contractor(s) shall conform to all laws, by-laws rules and regulations for the time being in force pertaining to the employment of local or imported labour and shall take all necessary precautions to ensure and preserve the health and safety of all staff employed directly or through petty contractors or sub-contractors on the works.
- 59.(3) Preservation of peace:** - The contractor shall take requisite precautions and use his best endeavours to
- (i) Prevent any riotous or unlawful behaviour by or amongst his workmen and other employed directly or through the petty contractors or sub-contractors on the works and for the preservation of peace and protection of the inhabitants and
  - (ii) Security of property in the neighbourhood of the works. In the event of the DFCCIL requiring the maintenance of a special Police Force at or in the vicinity of the site during the tenure of works, the expenses thereof shall be borne by the contractor and if paid by the DFCCIL shall be recoverable from the contractor.
- 59.(4) Sanitary Arrangements:** - The contractor shall obey all sanitary rules and carry out all sanitary measures that may from time to time be prescribed by the Local Medical Authority and permit inspection of all sanitary arrangements at all times by the Engineer, the Engineer's Representative or the Medical staff of the Local Medical Authority.
- 59.(5) Outbreak of infectious disease:** - The contractor shall remove from his camp such labour and their families as refuse protective inoculation and vaccination when called upon to do so by the Engineer or the Engineer's representative on the advice of the Local Medical Authority. Should cholera, plague or other infectious disease break out, the contractor shall burn the huts, beddings, clothes and other belongings of or used by the infected parties and promptly erect new huts on health sites as required by the Engineer, failing which within the time specified in the Engineer's requisition, the work may be done by the DFCCIL and the cost therefore recovered from the contractor.
- 59.(6) Deleted**
- 59.(7) Medical facilities at site:** - The Contractor shall provide medical facilities at the site as may be prescribed by the Engineer on the advice of the Local Medical Authority in relation to the strength of the Contractor's resident staff and workmen.
- 59.(8) Use of intoxicants:** - The sale of ardent spirits or other intoxicating beverages upon the work or in any of the buildings, encampments or tenements owned, occupied by or within the control of the contractor or any of his employees shall be forbidden and the Contractor shall exercise his influence and authority to the utmost extent to secure strict compliance with this condition.
- 59.(9) Restrictions On The Employment Of Retired Engineers Of Railway/DFCCIL Services Within one Year Of Their Retirement:** The Contractor shall not, if he is a retired Government Engineer of Gazetted rank, himself engage in or employ or associate a retired Government Engineer of Gazetted rank, who has not completed one year from the date of retirement, in connection with this contract in any manner whatsoever without obtaining prior permission of the President and if the Contractor is

found to have contravened this provision it will constitute a breach of contract and administration will be entitled to terminate the contract and forfeit his Performance Guarantee as well as Security Deposit.

- 60.(1) Non-employment of labours below the age of 15:** - The Contractor shall not employ children below the age of 15 as labourers directly or through petty contractors or subcontractors for the execution of work.
- 60.(2) Medical Certificate of fitness for labour:** - It is agreed that the contractor shall not employ a person above 15 and below 19 years of age for the purpose of execution of work under the contract unless a medical certificate of fitness in the prescribed form (**Proforma at Form No. 15**) granted to him by a certifying surgeon certifying that he is fit to work as an adult, is obtained and kept in the custody of the contractor or a person nominated by him in this behalf and the person carries with him, while at work; a token giving a reference to such certificate. It is further agreed that the responsibility for having the adolescent examined medically at the time of appointment or periodically till he attains the age of 19 years shall devolve entirely on the contractor and all the expenses to be incurred on this account shall be borne by him and no fee shall be charged from the adolescent or his parent for such medical examination.
- 60.(3) Period of validity of medical fitness certificate:** - A certificate of fitness granted or renewed for the above said purposes shall be valid only for a period of one year at a time. The certifying surgeon shall revoke a certificate granted or renewed if in his opinion the holder of it is, no longer fit for work in the capacity stated therein. Where a certifying surgeon refuses to grant or renew a certificate or revoke a certificate, he shall, if so, required by the person concerned, state his reasons in writing for doing so.
- 60.(4) Medical re-examination of labourer:-** Where any official appointed in this behalf by the Ministry of labour is of the opinion that any person employed in connection with the execution of any work under this contract in the age group 15 to 19 years is without a certificate of fitness or is having a certificate of fitness but no longer fit to work in the capacity stated in the certificate, he may serve on the Contractor, or on the person nominated by him in the regard, a notice requiring that such persons shall be examined by a certifying surgeon and such person shall not if the concerned official so directs, be employed or permitted to do any work under this contract unless he has been medically examined and certified that he is fit to work in the capacity stated in the certificate.

**EXPLANATIONS: -**

- (1) Only qualified medical practitioners can be appointed as “Certifying Surgeons” and the term “Qualified Medical Practitioners” means a person holding a qualification granted by an authority specified in the Schedule to the Indian Medical Degrees Act, 1916 (*VII to 1916*) or in the Schedule to the Indian Medical Council Act, 1933 (*XXVII*) of 1933.
- (2) The Certifying surgeon may be a medical officer in the service of State or Municipal Corporation.

**DETERMINATION OF CONTRACT**

- 61.(1) Right of DFCCIL of determine the contract:-** The DFCCIL shall be entitled to determine and terminate the contract at any time should, in the DFCCIL’s opinion, the cessation of work becomes necessary owing to paucity of funds or from any other cause whatever, in which case the

value of approved materials at site and of work done to date by the Contractor will be paid for in full at the rate specified in the contract. Notice in writing from the DFCCIL of such determination and the reasons therefore shall be conclusive evidence thereof.

**61. (2) Payment on determination of contract:** - Should the contract be determined under sub clause (1) of this clause and the Contractor claims payment for expenditure incurred by him in the expectation of completing the whole of the work, the DFCCIL shall admit and consider such claims as are deemed reasonable and are supported by vouchers to the satisfaction of the Engineer. The DFCCIL's decision on the necessity and propriety of such expenditure shall be final and conclusive.

**61.(3)** The contractor shall have no claim to any payment of compensation or otherwise, howsoever on account of any profit or advantage which he might have derived from the execution of the work in full but which he did not derive in consequence of determination of contract.

**62.(1) Determination of contract owing to default of contractor:** - If the Contractor should: -

- (i) Becomes bankrupt or insolvent, or
- (ii) Make an arrangement with of assignment in favour of his creditors, or agree to carry out the contract under a Committee of Inspection of his creditors, or
- (iii) Being a Company or Corporation, go into liquidation (*other than a voluntary liquidation for the purposes of amalgamation or reconstruction*), or
- (iv) Have an execution levied on his goods or property on the works, or
- (v) Assign the contract or any part thereof otherwise than as provided in Clause 7 of these conditions, or
- (vi) Abandon the contract, or
- (vii) Persistently disregard the instructions of the Engineer, or contravene any provision of the contract, or
- (viii) Fail to adhere to the agreed programme of work by a margin of 10% of the stipulated period, or
- (ix) Fail to execute the contract documents in terms of Clause 1.3.7 of the Preamble and Instructions to Bidder in Part-I, Chapter-III of Tender Document.
- (x) Fails to submit the documents pertaining to identity of JV and PAN in terms of Clause 1.3.17.11 of Tender Form available in the Regulations for Tenders and Contracts.
- (xi) Fail to remove materials from the site or to pull down and replace work after receiving from the Engineer notice to the effect that the said materials or works have been condemned or rejected under Clause 25 and 27 of these Conditions, or
- (xii) Fail to take steps to employ competent or additional staff and labour as required under Clause 26 of the Conditions, or
- (xiii) Fail to afford the Engineer or Engineer's representative proper facilities for inspecting the work or any part thereof as required under clause 28 of the conditions, or
- (xiv) Promise, offer or give any bribe, commission, gift or advantage either himself or through his

partner, agent or servant to any officer or employee of the DFCCIL or to any person on his or on their behalf in relation to the execution of this or any other contract with this DFCCIL.

- (xv) Fail to adhere to the provisions specified in “**Preamble & Instructions to Tenderers**”, Part-I, Chapter-III of Tender Document or Provision of above Clause 59(9).
- (xvi) Submits copy of fake documents/certifications in support of credentials, submitted by the tenderer

Then and in any of the said Clause, the Engineer on behalf of the DFCCIL may serve the Contractor with a notice (**Proforma at Form no. 16**) in writing to that effect and if the Contractor does not within seven days after the delivery to him of such notice proceed to make good his default in so far as the same is capable of being made good and carry on the work or comply with such directions as aforesaid of the entire satisfaction of the Engineer, the DFCCIL shall be entitled after giving 48 hours’ notice (**Proforma at Form no. 17 or 17A, as the case may be**) in writing under the hand of the Engineer to rescind the contract as a whole or in part or parts (as may be specified in such notice) and after expiry of 48 hours’ notice, a final termination notice (**Proforma at Form no. 16 or 18A, as the case may be**) should be issued.

**Note:** Engineer at his discretion may resort to the part termination of contract with notices (**Proforma at Form no. 16, 17A and 18A**), only in cases where progress of work is more than or equal to 80% of the original scope of work.

#### **62.(2) Right of DFCCIL after, rescission of contract owing to default of contractor:**

In the event of any or several of the courses, referred to in sub-clause (1) of the clause, being adopted.

- (a) The Contractor shall have no claim to compensation for any loss sustained by him by reason of his having purchased or procured any materials or entered into any commitments or made any advances on account of or with a view to the execution of the works or the performance of the contract and Contractor shall not be entitled to recover or be paid any sum for any work thereto for actually performed under the contract unless and until the Engineer shall have certified the performance of such work and the value payable in respect thereof and the Contractor shall only be entitled to be paid the value so certified.
- (b) In the contract which has been rescinded as a whole, the Security Deposit already with DFCCIL under the contract shall be encashed/ forfeited and the Performance Guarantee already submitted for the contract shall be encashed. The balance work shall be got done independently without risk & cost of the failed Contractor. The failed Contractor shall be debarred from participating in the tender for executing the balance work. If the failed Contractor is a JV or a Partnership firm, then every member/partner of such a firm shall be debarred from participating in the tender for the balance work in his/her individual capacity or as a partner of any other JV /partnership firm.

Further the authorized representative of failed Contractor cannot be accepted as authorized representative in new contract.

- (c) In the contract rescinded in part or parts,

- (i) The full Performance Guarantee for the contract shall be recovered. No additional Performance Guarantee shall be required for balance of work being executed through the part terminated contract. The contract value of part terminated contract stands reduced to the balance value of work under the contract.
- (ii) The Security Deposit of part terminated contract shall be dealt as per clause 16(2) of GCC.
- (iii) The defaulting Contractor shall not be issued any completion certificate for the contract.
- (iv) The balance work shall be got done independently without risk & cost of the failed Contractor. The failed Contractor shall be debarred from participating in the tender for executing the balance work. If the failed Contractor is a JV or a Partnership firm, then every member/partner of such a firm shall be debarred from participating in the tender for the balance work in his/her individual capacity or as a partner of any other JV /partnership firm.
- (v) Further the authorized representative of failed Contractor will not be accepted as authorized representative in new contract.
- (d) The Engineer or the Engineer's Representative shall be entitled to take possession of any materials, tools, implements, machinery and buildings on the works or on the property on which these are being or ought to have been executed, and to retain and employ the same in the further execution of the works or any part thereof until the completion of the works without the Contractor being entitled to any compensation for the use and employment thereof or for wear and tear or destruction thereof.
- (e) The Engineer shall as soon as may be practicable after removal of the Contractor fix and determine ex-parte or by or after reference to the parties or after such investigation or enquiries as he may consider fit to make or institute and shall certify what amount (if any) had at the time of rescission of the contract been reasonably earned by or would reasonably accrue to the Contractor in respect of the work then actually done by him under the contract and what was the value of any unused, or partially used materials, any constructional plant and any temporary works upon the site. The legitimate amount due to the Contractor after making necessary deductions and certified by the Engineer should be released expeditiously.

### **SETTLEMENT OF DISPUTES**

**63.0 Conciliation of disputes:** All disputes and differences of any kind whatsoever arising out of or in connection with the contract, whether during the progress of the work or after its completion and whether before or after the determination of the contract, shall be referred by the Contractor to the CGM)" through "Notice of Dispute" provided that no such notice shall be served later than 30 days after the date of issue of Completion Certificate by the Engineer. MD/DFCCIL shall, within 30 days after receipt of the Contractor's "Notice of Dispute", notify the name of conciliator(s) to the Contractor.

The Conciliator(s) shall assist the parties to reach an amicable settlement in an independent and impartial manner within the terms of contract.

If the parties reach agreement on a settlement of the dispute, they shall draw up and sign a written settlement agreement duly signed by DFCCIL, Contractor and conciliator(s). When the parties sign the settlement agreement, it shall be final and binding on the parties.

The parties shall not initiate, during the conciliation proceedings, any arbitral or judicial proceedings in respect of a dispute that is the subject matter of the conciliation proceedings.

The conciliation proceedings shall be terminated as per Section 76 of 'The Arbitration and Conciliation Act, 1996.

**63.1 Matters Finally Determined by the DFCCIL:** All disputes and differences of any kind whatsoever arising out of or in connection with the contract, whether during the progress of the work or after its completion and whether before or after the determination of the contract, shall be referred by the Contractor to the MD/DFCCIL and the MD/DFCCIL shall, within 120 days after receipt of the Contractor's representation, make and notify decisions on all matters referred to by the Contractor in writing provided that matters for which provision has been made in Clauses 7(j), 8, 18, 22(5), 39, 43(2), 45(i)(a), 55, 55-A(5), 57, 57A, 61(1), 61(2) and 62(1) of Standard General Conditions of Contract or in any Clause (stated as excepted matter) of the Special Conditions of the Contract, shall be deemed as 'excepted matters' (matters not arbitrable) and decisions of the DFCCIL Authority, thereon shall be final and binding on the Contractor; provided further that 'excepted matters' shall stand specifically excluded from the purview of the Arbitration Clause.

**64. (1) Demand for Arbitration: -**

- 64. (1)(i)** In the event of any dispute or difference between the parties hereto as to the construction or operation of this contract, or the respective rights and liabilities of the parties on any matter in question, dispute or difference on any account or as to the withholding by the DFCCIL of any certificate to which the Contractor may claim to be entitled to, or if the DFCCIL fails to make a decision within 120 days, then and in any such case, but except in any of the "excepted matters" referred to in Clause 63.1 of these Conditions, the Contractor, after 120 days but within 180 days of his presenting his final claim on disputed matters shall demand in writing that the dispute or difference be referred to arbitration.
- 64.(1) (ii)(a)** The demand for arbitration shall specify the matters which are in question, or subject of the dispute or difference as also the amount of claim item-wise. Only such dispute or difference, in respect of which the demand has been made, together with counter claims or set off, given by the DFCCIL, shall be referred to arbitration and other matters shall not be included in the reference.
- 64.(1)(ii)(b)** The parties may waive off the applicability of Sub-Section 12(5) of Arbitration and Conciliation (Amendment) Act 2015, if they agree for such waiver in writing, after dispute having arisen between them, in the format given under **(Form No. 25)** of these conditions.
- 64.(1)(iii)(a)** The Arbitration proceedings shall be assumed to have commenced from the day, a written and valid demand for arbitration is received by the DFCCIL.
- 64.(1)(iii)(b)** The claimant shall submit his claim stating the facts supporting the claims alongwith all the relevant documents and the relief or remedy sought against each claim within a period of 30 days from the date of appointment of the Arbitral Tribunal.

- 64.(1)(iii)(c)** The DFCCIL shall submit its defence statement and counter claim(s), if any, within a period of 60 days of receipt of copy of claims from Tribunal, unless otherwise extension has been granted by Tribunal.
- 64.(1)(iii)(d) Place of Arbitration:** The place of arbitration would be within the geographical limits of the CGM Unit where the cause of action arose or the Headquarters of the DFCCIL or any other place with the written consent of both the parties.
- 64.(1)(iv)** No new claim shall be added during proceedings by either party. However, a party may amend or supplement the original claim or defence thereof during the course of arbitration proceedings subject to acceptance by Tribunal having due regard to the delay in making it.
- 64.(1)(v)** If the Contractor(s) does/do not prefer his/their specific and final claims in writing, within a period of 90 days of receiving the intimation from the DFCCIL that the final bill is ready for payment, he/they will be deemed to have waived his/their claim(s) and the DFCCIL shall be discharged and released of all liabilities under the contract in respect of these claims.
- 64.(2) Obligation During Pendency of Arbitration:** Work under the contract shall, unless otherwise directed by the Engineer, continue during the arbitration proceedings, and no payment due or payable by the Railway shall be withheld on account of such proceedings, provided, however, it shall be open for Arbitral Tribunal to consider and decide whether or not such work should continue during arbitration proceedings.
- 64.(3) Appointment of Arbitrator**
- 64.(3)(a)(i)** In cases where the total value of all claims in question added together does not exceed ₹ 1,00,00,000/- (Rupees One Crore), the Arbitral Tribunal shall consist of a Sole Arbitrator nominated by MD/DFCCIL from approved panel of Arbitrators in DFCCIL. The sole arbitrator shall be appointed within 60 days from the day when a written and valid demand for arbitration is received by MD/DFCCIL.
- 64.(3)(a)(ii)** In cases not covered by the Clause 64(3)(a)(i), the Arbitral Tribunal shall consist of a panel of three Officials, as the Arbitrators. For this purpose, the DFCCIL will send a panel of Three (3) names empanelled Arbitrators to work as Arbitrator to the contractor within 60 days from the day when a written and valid demand for Arbitration is received by the MD/DFCCIL. Contractor will be asked to suggest to MD/DFCCIL at least 2 names out of the panel for appointment as Contractor's nominee within 30 days from the date of dispatch of the request by DFCCIL. The MD/DFCCIL shall appoint at least one out of them as the Contractor's nominee and will, also simultaneously appoint the second Arbitrator.
- (b)** Third member, who will also act as the presiding member, will be appointed by mutual consent of the first two members from the list of empanelled DFCCIL Arbitrators. If these two members fail to reach an agreement on the third member then, on request by either or both parties, appointment will be made by the MD/DFCCIL.
- (c)** The tribunal shall have full power to open up, review and revise any certificate, determination, instruction, opinion or valuation of the Engineer, and any decision of the conciliator/s relevant to the dispute.



- (d) Neither party shall be limited in the proceedings before the tribunal to the evidence or arguments previously put before the conciliator/s to obtain its decision, or to the reasons for dissatisfaction given in its notice of dissatisfaction.
  - (e) Arbitration may be commenced prior to or after completion of the works. The obligations of the Parties, the Engineer and the conciliator/s shall not be altered by reason of any arbitration being conducted during the progress of the Works.
- 64.(3)(a)(iii)** If one or more of the arbitrators appointed as above refuses to act as arbitrator, withdraws from his office as arbitrator, or vacates his/their office/offices or is/are unable or unwilling to perform his functions as arbitrator for any reason whatsoever or dies or in the opinion of the MD/DFCCIL fails to act without undue delay, the MD/DFCCIL shall appoint new arbitrator/arbitrators to act in his/their place in the same manner in which the earlier arbitrator/arbitrators had been appointed. Such re-constituted Tribunal may, at its discretion, proceed with the reference from the stage at which it was left by the previous arbitrator(s).
- 64.(3)(b)(i):(a)** The Arbitral Tribunal shall have power to call for such evidence by way of affidavits or otherwise as the Arbitral Tribunal shall think proper, and it shall be the duty of the parties hereto to do or cause to be done all such things as may be necessary to enable the Arbitral Tribunal to make the award without any delay. The proceedings shall normally be conducted on the basis of documents and written statements.
- (b) Before proceedings into the merits of any dispute, the Arbitral Tribunal shall first decide and pass its orders over any plea submitted/objections raised by any party, if any, regarding appointment of Arbitral Tribunal, validity of arbitration agreement, jurisdiction and scope of the Tribunal to deal with the dispute(s) submitted to arbitration, applicability of time 'limitation' to any dispute, any violation of agreed procedure regarding conduct of the arbitral proceedings or plea for interim measures of protection and record its orders in day to day proceedings. A copy of the proceedings duly signed by all the members of tribunal should be provided to both the parties.
- 64.3(c)(i):** The arbitral award shall state item wise, the sum and reasons upon which it is based. The analysis and reasons shall be detailed enough so that the award could be inferred therefrom.
- 64.3(c)(ii):** A party may apply for corrections of any computational errors, any typographical or clerical errors or any other error of similar nature occurring in the award of a Tribunal and interpretation of a specific point of award to Tribunal within 60 days of receipt of the award.
- 64.3(c)(iii):** A party may apply to Tribunal within 60 days of receipt of award to make an additional award as to claims presented in the arbitral proceedings but omitted from the arbitral award.
- 64.(4):** In case of the Tribunal, comprising of three members, any ruling on award shall be made by a majority of members of Tribunal. In the absence of such a majority, the views of the Presiding Arbitrator shall prevail.
- 64.(5):** Where the arbitral award is for the payment of money, no interest shall be payable on whole or any part of the money for any period till the date on which the award is made.

- 64.(6):** The cost of arbitration shall be borne by the respective parties. The cost shall inter-alia include fee of the arbitrator(s), as per the rates fixed by DFCCIL from time to time and the fee shall be borne equally by both the parties, provided parties sign an agreement in the format given at “**Form No. 25**” to these conditions after/ while referring these disputes to Arbitration. Further, the fee payable to the arbitrator(s) would be governed by the instructions issued on the subject by DFCCIL from time to time irrespective of the fact whether the arbitrator(s) is/are appointed by the DFCCIL or by the court of law unless specifically directed by Hon’ble court otherwise on the matter.
- 64.(7)** Subject to the provisions of the aforesaid Arbitration and Conciliation Act 1996 and the rules thereunder and relevant para of General Conditions of Contract (GCC) and any statutory modifications thereof shall apply to the appointment of arbitrators and arbitration proceedings under this Clause.

**Part- I**  
**Chapter-V**  
**Special Conditions of Contract**

**PART-I****CHAPTER-V****SPECIAL CONDITIONS OF CONTRACT****SPECIAL CONDITIONS (SECTION-1)**

**Note:** *The Special Conditions of contract (SCC) should be read in conjunction with the General Conditions of Contract (GCC). However, if there is any provision in the GCC, which is at variance with the provisions in SCC, the provisions in the Special Conditions of Contract (SCC) shall take precedence.*

**1.1 (A)** As per the provisions of Make in India policy 2017 local component should be min. 50% of the Contract value in totality. Contractor shall provide a undertaking of the same along with the supporting documents.

**(B)** The amended provisions for public procurement circulated by Ministry of Finance (MoF) – Dept of Expenditure – Public procurement Division **OM No. F No. 6/18/2019 – PPD dated 23-07-2020** would be applicable in this tender also. The copy of the same is enclosed herewith for ready reference.

**1.2 Electrical Contractor License**

1.2.1 For execution of Electrical works, a valid Electrical Contractor License is a must.

1.2.2 For execution of Electrical works, a valid Electrical Supervisor License is a must.

**1.3 Warranty/Guarantee period for Specialized Items :**

1.3.1 The contractor has to provide OEM Warranty certificates in the name of DFCCIL for specialized items. In case of specialized items become obsolete in the market, OEM support for such items (spare parts/ technical support) is to be provided for complete defect liability period or as specified after completion of Warranty period or as specified in the bill of quantities or technical specifications. Warranties shall be in the form of Certificates issued by the Manufacturer/OEM in the name of DFCCIL clearly specifying the period of warranty, quantity & description of items.

1.3.2 The procurement of specialized items/ equipments (such as IT, Audio Video System & Networking etc.) shall be planned by the contractor such that, the specialized items/ equipments shall not be purchased more than **03 months** from the date of commissioning of building or as instructed by Engineer.

1.3.3 The procurement of specialized items/ equipments (such as IT, Audio Video System & Networking etc.) should be as per specification given in Bill of Quantities/ Technical Specification. If in case, the specialised item/ equipment is out of market/ upgradation of technology/discontinued by the Company or OEM, the specialised item/ equipment with latest/upgraded version may be installed with the prior approval of Engineer.

1.3.5 All LED Luminaries shall have a replacement guarantee of 5 years from date of completion of work from OEM. The Contractor has to submit the guarantee certificate from OEM in the name of DFCCIL for the same.

### 1.3.9 Special Conditions for HVAC Works

- (i) Memorandum of Understanding (MOU) with OEM of VRV/VRF shall be submitted by the Contractor that OEM shall provide all spares and Technical supports required for maintenance of VRV/VRF to undertake the DLP/CAMC under the Contract no. .... to the Contractor-, ..... (Name of the Contractor) for the period of Contract (DLP+ minimum 7 years). This MOU shall be signed by Authorized Representative of OEM.

### 1.4 Handing Over Schedule:

- 1.4.1 On completion of all items of work as per contract, the Agency shall hand over the works to DFCCIL. The handing over of the completed works in all respect to DFCCIL (officially in writing) shall be the responsibility of the Agency. The defect liability period will commence from the date of handing/taking over to the DFCCIL. The process of handing over shall be as under:

One month in advance of the stipulated date of completion, joint inspection shall be carried out with Agency and Engineer's/DFCCIL representatives and all the defects, deficiencies shall be noted and a time bound programme to be made for rectifying/making good all the defects and deficiencies. After removing all defects, deficiencies at its own cost upto the satisfaction of Engineer/DFCCIL, the agency shall handover the building premises to DFCCIL.

The Agency shall remove at his own cost all surplus materials, debris, material waste, labour hutments before handing over to Engineer/DFCCIL. If it is felt that the Agency is not responding to rectify the defects urgently and the Engineer/DFCCIL is suffering in using the assets created due to default of the contract, Engineer/DFCCIL shall be entitled to get the defects rectified at the risk and cost of the Agency at any time after expiry of 24 hours notice issued to the Agency.

### 1.4.2 Approved Makes/Brands:

- 1.5.1 The brands/makes of the items would be executed as per the “List of Approved Makes” provided in the Tender Document. However, colour coding, shade or design shall be the discretion of the Engineer.
- 1.5.2 In case of non-availability of the brand/make specified in the approved list, the agency shall be allowed to use alternate equivalent brands of the material subject to approval of the same from Engineer/DFCCIL.
- 1.5.3 The agency has to submit requisite catalogues and samples of the material to Engineer/DFCCIL before approval and ensure that the supply would only be taken by agency after the materials are duly approved by DFCCIL.
- 1.5.4 The agency has to produce Manufacturer Test Certificates (MTC), Warranty Certificates/Invoices for material/equipment supplied for certification and approval.
- 1.5.5 Submittals and samples must be approved from Engineer/DFCCIL before supply.

F.No 6/18/2019-PPD  
Ministry of Finance  
Department of Expenditure  
Public Procurement Division


161, North Block,  
New Delhi  
23rd July, 2020

**Office Memorandum**

**Subject: Insertion of Rule 144 (xi) in the General Financial Rules (GFRs), 2017**

Rule 144 of the General Financial Rules 2017 entitled 'Fundamental principles of public buying', has been amended by inserting sub-rule (xi) as under:

*Notwithstanding anything contained in these Rules, Department of Expenditure may, by order in writing, impose restrictions, including prior registration and/or screening, on procurement from bidders from a country or countries, or a class of countries, on grounds of defence of India, or matters directly or indirectly related thereto including national security; no procurement shall be made in violation of such restrictions.*

  
(Sanjay Prasad)  
Joint Secretary (PPD)  
Email ID: [js.pfc2.doe@gov.in](mailto:js.pfc2.doe@gov.in)  
Telephone: 011-23093882

- To,
- (1) Secretaries of All Ministries/ Departments of Government of India
  - (2) Chief Secretaries/ Administrators of Union Territories/ National Capital Territory of Delhi

F.No.6/18/2019-PPD  
Ministry of Finance  
Department of Expenditure  
Public Procurement Division

161, North Block,  
New Delhi  
23rd July, 2020

**Order (Public Procurement No. 1)**

**Subject: Restrictions under Rule 144 (xi) of the General Financial Rules (GFRs), 2017**

Attention is invited to this office OM no. 6/18/2019-PPD dated 23<sup>rd</sup> July 2020 inserting Rule 144 (xi) in GFRs 2017. In this regard, the following is hereby ordered under Rule 144 (xi) on the grounds stated therein:

**Requirement of registration**

1. Any bidder from a country which shares a land border with India will be eligible to bid in any procurement whether of goods, services (including consultancy services and non-consultancy services) or works (including turnkey projects) only if the bidder is registered with the Competent Authority, specified in **Annex I**.
2. This Order shall not apply to (i) cases where orders have been placed or contract has been concluded or letter/notice of award/ acceptance (LoA) has been issued on or before the date of this order; and (ii) cases falling under **Annex II**.

**Transitional cases**

3. Tenders where no contract has been concluded or no LoA has been issued so far shall be handled in the following manner: -
  - a) *In tenders which are yet to be opened, or where evaluation of technical bid or the first exclusionary qualificatory stage (i.e. the first stage at which the qualifications of tenderers are evaluated and unqualified bidders are excluded) has not been completed: No contracts shall be placed on bidders from such countries. Tenders received from bidders from such countries shall be dealt with as if they are non-compliant with the tender conditions and the tender shall be processed accordingly.*
  - b) *If the tendering process has crossed the first exclusionary qualificatory stage: If the qualified bidders include bidders from such countries, the*

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entire process shall be scrapped and initiated *de novo*. The *de novo* process shall adhere to the conditions prescribed in this Order.

- c) As far as practicable, and in cases of doubt about whether a bidder falls under paragraph 1, a certificate shall be obtained from the bidder whose bid is proposed to be considered or accepted, in terms of paras 8, 9 and 10 read with para 1 of this Order.

#### Incorporation in tender conditions

4. In tenders to be issued after the date of this order, the provisions of paragraph 1 and of other relevant provisions of this Order shall be incorporated in the tender conditions.

#### Applicability

5. Apart from Ministries / Departments, attached and subordinate bodies, notwithstanding anything contained in Rule 1 of the GFRs 2017, this Order shall also be applicable
  - a. to all Autonomous Bodies;
  - b. to public sector banks and public sector financial institutions; and
  - c. subject to any orders of the Department of Public Enterprises, to all Central Public Sector Enterprises; and
  - d. to procurement in Public Private Partnership projects receiving financial support from the Government or public sector enterprises/ undertakings.
  - e. Union Territories, National Capital Territory of Delhi and all agencies/ undertakings thereof

#### Definitions

6. "Bidder" for the purpose of this Order (including the term 'tenderer', 'consultant' 'vendor' or 'service provider' in certain contexts) means any person or firm or company, including any member of a consortium or joint venture (that is an association of several persons, or firms or companies), every artificial juridical person not falling in any of the descriptions of bidders stated hereinbefore, including any agency, branch or office controlled by such person, participating in a procurement process.
7. "Tender" for the purpose of this Order will include other forms of procurement, except where the context requires otherwise.
8. "Bidder from a country which shares a land border with India" for the purpose of this Order means

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- a) An entity incorporated, established or registered in such a country; or
- b) A subsidiary of an entity incorporated, established or registered in such a country; or
- c) An entity substantially controlled through entities incorporated, established or registered in such a country; or
- d) An entity whose *beneficial owner* is situated in such a country; or
- e) An Indian (or other) agent of such an entity; or
- f) A natural person who is a citizen of such a country; or
- g) A consortium or joint venture where any member of the consortium or joint venture falls under any of the above

9. "Beneficial owner" for the purpose of paragraph 8 above will be as under:

- (i) In case of a company or Limited Liability Partnership, the beneficial owner is the natural person(s), who, whether acting alone or together, or through one or more juridical person(s), has a controlling ownership interest or who exercises control through other means.

Explanation—

- a. "Controlling ownership interest" means ownership of, or entitlement to, more than twenty-five per cent of shares or capital or profits of the company;
- b. "Control" shall include the right to appoint the majority of the directors or to control the management or policy decisions, including by virtue of their shareholding or management rights or shareholders agreements or voting agreements;
- (ii) In case of a partnership firm, the beneficial owner is the natural person(s) who, whether acting alone or together, or through one or more juridical person, has ownership of entitlement to more than fifteen percent of capital or profits of the partnership;
- (iii) In case of an unincorporated association or body of individuals, the beneficial owner is the natural person(s), who, whether acting alone or together, or through one or more juridical person, has ownership of or entitlement to more than fifteen percent of the property or capital or profits of such association or body of individuals;
- (iv) Where no natural person is identified under (i) or (ii) or (iii) above, the beneficial owner is the relevant natural person who holds the position of senior managing official;

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(v) In case of a trust, the identification of beneficial owner(s) shall include identification of the author of the trust, the trustee, the beneficiaries with fifteen percent or more interest in the trust and any other natural person exercising ultimate effective control over the trust through a chain of control or ownership.

10. "Agent" for the purpose of this Order is a person employed to do any act for another, or to represent another in dealings with third persons.

#### Sub-contracting in works contracts

11. In works contracts, including turnkey contracts, contractors shall not be allowed to sub-contract works to any contractor from a country which shares a land border with India unless such contractor is registered with the Competent Authority. The definition of "contractor from a country which shares a land border with India" shall be as in paragraph 8 above. This shall not apply to sub-contracts already awarded on or before the date of this Order.

#### Certificate regarding compliance

12. A certificate shall be taken from bidders in the tender documents regarding their compliance with this Order. If such certificate given by a bidder whose bid is accepted is found to be false, this would be a ground for immediate termination and further legal action in accordance with law.

#### Validity of registration

13. In respect of tenders, registration should be valid at the time of submission of bids and at the time of acceptance of bids. In respect of supply otherwise than by tender, registration should be valid at the time of placement of order. If the bidder was validly registered at the time of acceptance / placement of order, registration shall not be a relevant consideration during contract execution.

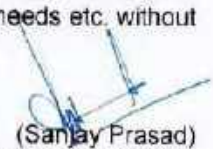
#### Government E-Marketplace

14. The Government E-Marketplace shall, as soon as possible, require all vendors/ bidders registered with GeM to give a certificate regarding compliance with this Order, and after the date fixed by it, shall remove non-compliant entities from GeM unless/ until they are registered in accordance with this Order.

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Model Clauses/ Certificates

15. Model Clauses and Model Certificates which may be inserted in tenders / obtained from Bidders are enclosed as **Annex III**. While adhering to the substance of the Order, procuring entities are free to appropriately modify the wording of these clauses based on their past experience, local needs etc. without making any reference to this Department.

  
(Sanjay Prasad)  
Joint Secretary (PPD)  
Email ID: [js.pfc2.doe@gov.in](mailto:js.pfc2.doe@gov.in)  
Telephone: 011-23093882

To

- (1) Secretaries of All Ministries/ Departments of Government of India for information and necessary action. They are also requested to inform these provisions to all procuring entities.
- (2) Secretary, Department of Public Enterprises with a request to immediately reiterate these orders in respect of Public Enterprises.
- (3) Secretary DPIIT with a request to initiate action as provided under Annex I
- (4) Chief Secretaries/ Administrators of Union Territories/ National Capital Territory of Delhi

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### **Annex I: Competent Authority and Procedure for Registration**

- A. The Competent Authority for the purpose of registration under this Order shall be the Registration Committee constituted by the Department for Promotion of Industry and Internal Trade (DPIIT)\*.
- B. The Registration Committee shall have the following members\*:
- i. An officer, not below the rank of Joint Secretary, designated for this purpose by DPIIT, who shall be the Chairman;
  - ii. Officers (ordinarily not below the rank of Joint Secretary) representing the Ministry of Home Affairs, Ministry of External Affairs, and of those Departments whose sectors are covered by applications under consideration;
  - iii. Any other officer whose presence is deemed necessary by the Chairman of the Committee.
- C. DPIIT shall lay down the method of application, format etc. for such bidders as stated in para 1 of this Order.
- D. On receipt of an application seeking registration from a bidder from a country covered by para 1 of this Order, the Competent Authority shall first seek political and security clearances from the Ministry of External Affairs and Ministry of Home Affairs, as per guidelines issued from time to time. Registration shall not be given unless political and security clearance have both been received.
- E. The Ministry of External Affairs and Ministry of Home Affairs may issue guidelines for internal use regarding the procedure for scrutiny of such applications by them.
- F. The decision of the Competent Authority, to register such bidder may be for all kinds of tenders or for a specified type(s) of goods or services, and may be for a specified or unspecified duration of time, as deemed fit. The decision of the Competent Authority shall be final.
- G. Registration shall not be granted unless the representatives of the Ministries of Home Affairs and External Affairs on the Committee concur\*.
- H. Registration granted by the Competent Authority of the Government of India shall be valid not only for procurement by Central Government and its agencies/ public enterprises etc. but **also for procurement by State Governments and their agencies/ public enterprises etc. No fresh registration at the State level shall be required.**

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- I. The Competent Authority is empowered to cancel the registration already granted if it determines that there is sufficient cause. Such cancellation by itself, however, will not affect the execution of contracts already awarded. Pending cancellation, it may also suspend the registration of a bidder, and the bidder shall not be eligible to bid in any further tenders during the period of suspension.
- J. For national security reasons, the Competent Authority shall not be required to give reasons for rejection / cancellation of registration of a bidder.
- K. In transitional cases falling under para 3 of this Order, where it is felt that it will not be practicable to exclude bidders from a country which shares a land border with India, a reference seeking permission to consider such bidders shall be made by the procuring entity to the Competent Authority, giving full information and detailed reasons. The Competent Authority shall decide whether such bidders may be considered, and if so shall follow the procedure laid down in the above paras.
- L. Periodic reports on the acceptance/ refusal of registration during the preceding period may be required to be sent to the Cabinet Secretariat. Details will be issued separately in due course by DPIIT.

[\*Note:

- i. In respect of application of this Order to procurement by/ under State Governments, all functions assigned to DPIIT shall be carried out by the State Government concerned through a specific department or authority designated by it. The composition of the Registration Committee shall be as decided by the State Government and paragraph G above shall not apply. However, the requirement of **political and security clearance as per para D shall remain and no registration shall be granted without such clearance.**
- ii. Registration granted by State Governments shall be valid only for procurement by the State Government and its agencies/ public enterprises etc. and shall not be valid for procurement in other states or by the Government of India and their agencies/ public enterprises etc.]

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**Annex II: Special Cases**

- A. Till 31<sup>st</sup> December 2020, procurement of medical supplies directly related to containment of the Covid-19 pandemic shall be exempt from the provisions of this Order.
- B. *Bona fide* procurements made through GeM without knowing the country of the bidder till the date fixed by GeM for this purpose, shall not be invalidated by this Order.
- C. *Bona fide* small procurements, made without knowing the country of the bidder, shall not be invalidated by this Order.
- D. In projects which receive international funding with the approval of the Department of Economic Affairs (DEA), Ministry of Finance, the procurement guidelines applicable to the project shall normally be followed, notwithstanding anything contained in this Order and without reference to the Competent Authority. Exceptions to this shall be decided in consultation with DEA.
- E. This Order shall not apply to procurement by Indian missions and by offices of government agencies/ undertakings located outside India.

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**Annex III****Model Clause /Certificate to be inserted in tenders etc.**

*(While adhering to the substance of the Order, procuring entities and GeM are free to appropriately modify the wording of the clause/ certificate based on their past experience, local needs etc.)*

**Model Clauses for Tenders**

- I. Any bidder from a country which shares a land border with India will be eligible to bid in this tender only if the bidder is registered with the Competent Authority.
- II. "Bidder" (including the term 'tenderer', 'consultant' or 'service provider' in certain contexts) means any person or firm or company, including any member of a consortium or joint venture (that is an association of several persons, or firms or companies), every artificial juridical person not falling in any of the descriptions of bidders stated hereinbefore, including any agency branch or office controlled by such person, participating in a procurement process.
- III. "Bidder from a country which shares a land border with India" for the purpose of this Order means: -
  - a. An entity incorporated, established or registered in such a country; or
  - b. A subsidiary of an entity incorporated, established or registered in such a country; or
  - c. An entity substantially controlled through entities incorporated, established or registered in such a country; or
  - d. An entity whose *beneficial owner* is situated in such a country; or
  - e. An Indian (or other) agent of such an entity; or
  - f. A natural person who is a citizen of such a country; or
  - g. A consortium or joint venture where any member of the consortium or joint venture falls under any of the above
- IV. The *beneficial owner* for the purpose of (iii) above will be as under:
  1. In case of a company or Limited Liability Partnership, the beneficial owner is the natural person(s), who, whether acting alone or together, or through one or more juridical person, has a controlling ownership interest or who exercises control through other means.  
Explanation—
    - a. "Controlling ownership interest" means ownership of or entitlement to more than twenty-five per cent. of shares or capital or profits of the company;

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- b. "Control" shall include the right to appoint majority of the directors or to control the management or policy decisions including by virtue of their shareholding or management rights or shareholders agreements or voting agreements;
2. In case of a partnership firm, the beneficial owner is the natural person(s) who, whether acting alone or together, or through one or more juridical person, has ownership of entitlement to more than fifteen percent of capital or profits of the partnership;
  3. In case of an unincorporated association or body of individuals, the beneficial owner is the natural person(s), who, whether acting alone or together, or through one or more juridical person, has ownership of or entitlement to more than fifteen percent of the property or capital or profits of such association or body of individuals;
  4. Where no natural person is identified under (1) or (2) or (3) above, the beneficial owner is the relevant natural person who holds the position of senior managing official;
  5. In case of a trust, the identification of beneficial owner(s) shall include identification of the author of the trust, the trustee, the beneficiaries with fifteen percent or more interest in the trust and any other natural person exercising ultimate effective control over the trust through a chain of control or ownership.
- V. An Agent is a person employed to do any act for another, or to represent another in dealings with third person.
- VI. *[To be inserted in tenders for Works contracts, including Turnkey contracts]* The successful bidder shall not be allowed to sub-contract works to any contractor from a country which shares a land border with India unless such contractor is registered with the Competent Authority.

**Model Certificate for Tenders (for transitional cases as stated in para 3 of this Order)**

*"I have read the clause regarding restrictions on procurement from a bidder of a country which shares a land border with India; I hereby certify that this bidder is not from such a country and is eligible to be considered."*

**Model Certificate for Tenders**

*"I have read the clause regarding restrictions on procurement from a bidder of a country which shares a land border with India; I certify that this bidder is not from such a country or, if from such a country, has been registered with the*

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*Competent Authority. I hereby certify that this bidder fulfills all requirements in this regard and is eligible to be considered. [Where applicable, evidence of valid registration by the Competent Authority shall be attached.]"*

**Model Certificate for Tenders for Works involving possibility of sub-contracting**

*"I have read the clause regarding restrictions on procurement from a bidder of a country which shares a land border with India and on sub-contracting to contractors from such countries; I certify that this bidder is not from such a country or, if from such a country, has been registered with the Competent Authority and will not sub-contract any work to a contractor from such countries unless such contractor is registered with the Competent Authority. I hereby certify that this bidder fulfills all requirements in this regard and is eligible to be considered. [Where applicable, evidence of valid registration by the Competent Authority shall be attached.]"*

**Model Certificate for GeM:**

*"I have read the clause regarding restrictions on procurement from a bidder of a country which shares a land border with India; I certify that this vendor/ bidder is not from such a country or, if from such a country, has been registered with the Competent Authority. I hereby certify that this vendor/ bidder fulfills all requirements in this regard and is eligible to be considered for procurement on GeM. [Where applicable, evidence of valid registration by the Competent Authority shall be attached.]"*

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**PART-I**  
**CHAPTER-V**  
**SPECIAL CONDITIONS OF CONTRACT**  
**SPECIAL CONDITIONS (SECTION-2)**

**Note:** *The Special Conditions of contract (SCC) should be read in conjunction with the General Conditions of Contract (GCC). However, if there is any provision in the GCC, which is at variance with the provisions in SCC, the provisions in the Special Conditions of Contract (SCC) shall take precedence.*

**2.1 TEMPORARY WORKERS' HOUSING:**

- 2.1.1** The bidder himself shall construct clean hygienic and well-ventilated labour housing with adequate water supply, electrical, sanitation facilities, etc as per "Model Rules for the Protection of Health and Sanitary Arrangement for the Workers Employed by the Contractors" of General Conditions of Contract, or applicable Labour Regulations.
- 2.1.2** The contractor has to arrange for the labour passes for entry and exit of labourers at the work site.
- 2.1.3** Adequate number of temporary housing units shall be constructed within two months of the date of start of work to the satisfaction of Engineer.
- 2.1.4** Toilet blocks having WC, wash basin and bathing area @ one set for approximately 15 labours with arrangement for sewage disposal through ready to install adequate capacity septic tank units shall be made available along with the labour huts.
- 2.1.5** These housing units can be inspected by Engineer/DFCCIL and contractor will be allowed to take up main work only after satisfactory completion of these units.
- 2.1.6** *No extra payment shall be made by DFCCIL for construction of such temporary labour housing.*

**2.2 Tool and Plants**

The required T&P shall be brought to site well in advance so as to ensure the progress of the work as per the Contract Schedule.

**2.3 Technical Staff:**

The contractor shall submit the list of engineers / technical staff with charter of duties / responsibilities of each one related to execution of the work after issue of Letter of Acceptance (as given below) and deploy the same at work site according to the requirement and progress of work as decided by Engineer. The decision of DFCCIL in this regard would be final and binding.

Requirement of technical representative(s)					
S.N.	Technical Representative	Designation of Technical Staff	Minimum experience	Number	Deduction per month on absentee
1.	Graduate Engineer	Project Manager/Civil	10 years	1 No.	Rs. 75,000/-
3.	Graduate Engineer/Electrical	Dy. Project Manager/Electrical	5 years	1 No.	Rs. 50,000/-
4.	Graduate Engineer or Diploma Engineer	Project/Site Engineer (Civil/Electrical/ IT)	5 Years or 10 Years respectively	3 Nos.	Rs. 30,000/-

#### 2.4 Compliance with GRIHA Guidelines

Agency is advised to note that entire work shall be carried out in such a manner so as to satisfy Green building parameters / GRIHA guidelines. Conditions of Contract specific to Green Building Practices have been narrated in Special Conditions for Green Building Practices (*Part-I, Chapter-V, Section-4 & 5*).

#### 2.5 Defects Liability Period (DLP)

2.5.1 Defects liability period shall be taken as **12 (Twelve) months** from the date of completion of the work for building as a whole, wherein, all the defects shall be rectified by the contractor at his own cost.

2.5.2 Defects of serious nature causing inconvenience such as leakage, reverse floor slopes affecting the drainage (*ponding of water*), *warping and opening of joints in doors and window shutters, etc.* shall be undertaken by the contractor immediately on receipt of the complaint but not exceeding one week time, failing which, the defects will be got removed at his risk and **cost plus 20% + GST extra** as supervision and establishment charges.

2.6.1 All other defects notified to the contractor during the DLP shall be rectified to the entire satisfaction of Engineer or item replaced as soon as possible but not beyond one month failing which, Engineer shall get it done at his **cost plus 20% + GST extra** as supervision and establishment charges. **The decision of Engineer regarding a defect being of serious nature or otherwise shall be final and binding.**

2.6.1 Contractor shall undertake the comprehensive maintenance/Defect liability for **12 (Twelve) months** after the certified date of completion of the buildings constructed or services provided in the building and shall include all labour material, T&P etc., required to attend any complaint lodged by the Engineer. The contractor shall make all the arrangement for receiving and recording the complaints through a maintenance cell & land for construction of site office and storage of material shall be provided by DFCCIL in the campus.

### 2.6.1 Other Conditions

- (a) The execution of items shall be carried out in accordance to relevant CPWD specifications (*amended upto date of receipt of tenders*). For the items which are not covered under CPWD specifications, the Technical Specifications provided in the Tender document / B.I.S. Specifications shall have to be followed. The decision of Engineer shall be final in this regard.
- (b) Wherever any reference is made to any Indian Standard, it shall be taken as reference to the latest edition with all amendments / revision issued thereto upto the date of receipt of tenders.
- (c) Unless otherwise specified, the agreement rates for all items of work of the Schedule of Quantities are for all heights, depths, leads and lifts involved in the execution of work.
- (d) The contractor shall make his own arrangement of water required for the work.
- (e) The contractor shall make his own arrangements for obtaining electric connection for carrying out any activity and make necessary payment to the department concerned. In the absence of electric connection or failure of power supply, the contractor shall make his own arrangements of generators etc..
- (f) Other agencies working at site will also simultaneously execute the work. The contractor shall offer necessary cooperation to other agencies wherever required.
- (g) On account of security consideration, there could be some restrictions on the working hours, movement of vehicles for transportation of materials, etc. The contractor shall be bound to follow all such restrictions and adjust the programmes for execution of works accordingly.
- (h) The work shall be carried out in a manner complying in all respects with the requirements of any prevalent statutory laws enacted either by Central Govt. as well as State Govt./Authority.
- (i) Any malba / building rubbish generated is to be removed from the site within 24 hours and to be stacked at a pre-designated place. The malba / building rubbish so stacked shall be disposed off as soon as one truck load is accumulated (*approx 5 cum*) from such designated place.
- (j) This malba / building rubbish has to be disposed off to the dumping ground as approved by the Engineer in consultation with DFCCIL. ***The rates quoted by the contractor are inclusive of all operations, labour, leads and lifts from site of work to the dumping ground.***
- (k) Maintenance Engineer/Supervisor shall carry mobile telephone (s) to enable the Engineer- in-Charge to have easy and quick communication. ***Nothing extra shall be paid to the contractor on this account and his quoted rates for various items under this contract will be inclusive of this obligation.***
- (l) The replaced materials used shall have same or richer specifications to the original materials and compatible to the work.
- (m) The staff employed by the contractor should be well behaved and any complaint of

misbehaviour shall be taken very seriously and such staff will have to be removed by the contractor immediately from the site.

- (n) The dismantled materials shall be taken away and disposed off by the contractor at his cost. ***Nothing extra shall be paid*** / recovered on account of this.
- (o) The contractor shall make all safety arrangements required for the labour engaged by him at his cost. All consequences due to negligence on behalf of security / safety or otherwise shall be on the contractor. The department shall not be responsible for any mishap, injury, accident or death of the contractor's staff. No claim in this regard shall be entertained / accepted by the department.
- (p) Contractor shall be fully responsible for any damages caused to government property or allottee's property by him or his labour in carrying out the work and shall be rectified by the contractor at his own cost.
- (q) Chases, holes, etc. shall be done using power operated tools.

## 2.6 Safety measures

2.6.1 The issue of construction safety & standards has gained utmost importance in recent times. This subject is to be dealt with, in an overall manner with an approach to developing and establishment a safety culture at work sites. Broadly, its components are:

- a Creating an awareness
- b Education
- c Training
- d Implementation
- e Enforcement measures

All workers of contractor and associate agencies, invariably and at all the times, must follow all safety norms, adopt safe construction practices and use all required safety gadgets in their working, throughout the project duration.

2.6.2 The ***contractor*** shall be primarily responsible for developing safety programs, training, implementation and propagating safety culture.

2.6.3 The contractor shall issue ***Photo Identity Cards*** with unique numbers containing salient information of workers. Further the contractor shall establish a ***Time Office*** at the entry to demarcate area of site.

## 2.7 Insurance:

Before commencing of works, it shall be obligatory for the Contractor to obtain, ***at his own cost, insurance cover*** in the ***joint name of the Contractor and Employer (DFCCIL)*** from reputed companies for the following requirements:

- a) Contractor's All Risk (CAR) Policy.

- b) Liability for death of or injury to any person or loss of or damage to any property (*other than the work*) arising out the performance of the contract.
- c) Construction Plant, Machinery and Equipment brought to site by the Contractor.
- d) Workmen Compensation Policy
- e) Any other insurance cover as may be required by the law of the land.
- f) The Contractor, if required, will engage a suitable Engineer to liaise with Insurer Company in the interest of realization of insurance claims at no cost to Employer.
- g) Contractor/Insurance Company shall have to indemnify DFCCIL for all losses. Claims if any given by insurance company to be given directly to DFCCIL. Decision of DFCCIL will be binding on Contractor to distribute claim in part or full.

All insurance covers referred to in the Contract shall be affected with an Indian Insurance Company incorporated and registered in India.

## 2.8 SECURITY

- 2.8.1 Contractor shall take all measures and precautions relating to security of the construction site. He shall **barricade the construction site** / designated area of construction through the barriers and as approved by the Engineer. No material shall be stored / dumped outside the designated area.
- 2.8.2 The movement of the construction vehicles and the labours shall be restricted to the designated routes which will be decided by the Engineer.
- 2.8.3 All the vehicles carrying the material to the work site shall be subject to check and entries to be made at the gates. No material shall be taken out without proper gate pass.
- 2.8.4 Any labour engaged by the contractor shall be in possession of photo ID card failing which they are liable to be disengaged from the work and shall not be allowed to enter into the construction site.
- 2.8.5 In case of any nuisance caused by activities attributed to contractors' staff, workmen and movement of vehicle, and reported to Engineer, a suitable action will be taken by the Engineer.
- 2.8.6 The movement of the labour shall be restricted to the barricaded work site area only.

## 2.9 CONSTRUCTION VEHICLES TYRE WASHING FACILITIES

All the vehicles leaving the site shall be loaded in such a manner that the excavated materials, mud or debris will not be deposited on roads. All such loads shall be covered or protected to prevent dust being emitted. The wheels of all vehicles shall be washed properly before leaving the site to avoid the deposition of mud and debris on the roads. Also, the contractor shall make necessary arrangements for sweeping and removal of mud from roads if it is deposited even after washing of wheels of vehicles leaving site. **Nothing extra shall be paid** for providing and maintaining this facility.

## 2.10 BARRICADING OF SITE

The contractor shall make adequate arrangement for new barricading as directed by the Engineer to cover the entire construction site including all T&P and materials. The requirement of providing and fixing new barricading at site shall be decided as per the direction and approval of Engineer.

The barricading shall be provided continuously during the execution of the entire work till completion and shall not be removed at any stage without prior approval of the Engineer. The barricading shall be provided and shall be the property of the contractor after completion of the work.

## **2.11 WATER SUPPLY**

Contractor shall be responsible for the arrangement to obtain supply of water necessary for the works at his own cost.

## **2.12 ELECTRIC SUPPLY**

Contractor shall be responsible for the arrangement to obtain supply of electric power necessary for the works at his own cost.

## **2.13 COMPLIANCE TO ENVIRONMENTAL LAWS**

The contractor shall comply the directives of Hon'ble National Green Tribunal dated 04.12.2014 & 10.04.2015 and EIA Guidance Manual issued in February 2010 and Construction & Demolition Waste Management Rules, 2016. The compliance of the contractor shall not be limited to the following:

1. The contractor shall not store/dump construction material or debris on metalled road.
2. The contractor shall get prior approval from Engineer for the area where the construction material or debris can be stored beyond the metalled road. This area shall not cause any obstruction to the free flow of traffic/inconvenience to the pedestrians. It should be ensured by the contractor that no accidents occur on account of such permissible storage.
3. The contractor shall take appropriate protection measures like raising wind breakers of appropriate height on all sides of the plot/area using CGI sheets or plastic and/or other similar material to ensure that no construction material dust fly outside the plot area.
4. The contractor shall ensure that all the trucks or vehicles of any kind which are used for construction purposes/or are carrying construction material like cement, sand and other allied material are fully covered. The contractor shall take every necessary precaution that the vehicle is properly cleaned and dust free to ensure that enroute their destination, the dust, sand or any other particles are not released in air/contaminate air.
5. The contractor shall provide mask to every worker working on the construction site and involved in loading, unloading and carriage of construction material and construction debris to prevent inhalation of dust particles.
6. The contractor shall provide all medical help, investigation and treatment to the workers involved in the construction of building and carry of construction material and debris relatable to dust emission.
7. The contractor shall ensure that C&D waste is transported to the approved C&D waste site of local authority only as per Construction & Demolition Waste Management Rules, 2016 and due record shall be maintained by the contractor.
8. The contractor shall compulsorily use jet in grinding and stone cutting.

9. The contractor shall comply all the preventive and protective environmental steps as stated in the MoEF Guidelines, 2010.
10. The contractor shall carry out On-Road-Inspection for black smoke generating machinery. The contractor shall use cleaner fuel.
11. The contractor shall ensure that the DG sets comply emission norms notified by MoEF.
12. The contractor shall use vehicles having pollution under control certificate. The emissions can be reduced by a large extent by reducing the speed of a vehicle to 20 kmph. Speed bumps shall be used to ensure speed reduction. In cases where speed reduction cannot effectively reduce fugitive dust, the contractor shall divert traffic to nearby paved areas.
13. The contractor shall ensure that the construction material is covered by tarpaulin. The contractor shall take all other precaution to ensure that no dust particles are permitted to pollute air quality as a result of such storage.

**2.14      *Nothing extra shall be paid on the account of above Special Conditions as stated above in Section-2 of Part-I, Chapter-V.***

2.15      Tenderer is advised to visit the site before submitting their bid to access the actual working conditions and quote rate accordingly. ***Nothing extra shall be payable on this account.***

2.16      The Contractor shall furnish for approval, with reasonable promptness, samples of all materials and workmanship. The Engineer shall check and confirm in consultation with Architect / Consultants, approval of such samples with reasonable promptness only to confirm with the design concept of the Works and for compliance with the information given in the contract documents. The work shall be in accordance with approved samples. The procedure for submission and approval of samples shall be as follows; -

- a)      All material samples in duplicate shall be delivered to the Engineer office at the Contractor's cost. Samples shall be properly labeled with.
  - Name of Project
  - Name of Contractor
  - Name Product
  - Name of Manufacturer
  - Reference No of Schedule of Quantities (BOQ)
  - Date of Submission
  - Date of fabrication / casting – if applicable
- b)      Samples shall be accompanied with technical specification / manufacturer's catalogue
- c)      In case the Contractor intends to keep an approved sample in his possession he shall submit one additional samples for the Architect/Engineer approval.
- d)      Samples shall be furnished well in advance to give the Architect/Engineer reasonable time for their consideration.



## 2.17 **SETTING OUT THE WORKS**

The Contractor shall arrange necessary instruments, equipments and personnel and shall establish lines and elevations at the site as required for completion of the Works as per architectural drawings. The proposed layout showing all grid lines and exterior wall locations and setting-out points, lines etc. shall be got checked from the Engineer.

All setting-out points / levels shall be protected during construction by the Contractor and he shall also be responsible for any intermediate setting-out points / levels required for the work.

## 2.18 **SUBMITTALS**

### 2.18.1 **SAMPLES**

The Contractor shall submit to Engineer samples of all materials for approval and no work shall commence before such samples are duly approved by Engineer. Samples of aluminium finishes, 300 mm square samples of each type of glass required, range of tinted / reflective glasses, glazing sealants, locking arrangements, hinges, hardware and other accessories and every other work requiring samples in the opinion of the Architect/Engineer shall be supplied to him by the Contractor and these samples will be retained as standards of materials and workmanship. The cost of the samples shall be borne by the Contractor.

### 2.18.2 **SHOP/WORKING/INSTALLATION DRAWINGS**

- (I) Contractor shall submit full scale fabrication and /or installation and/or assembly drawings for each type of works and for all parts of the work in sufficient detail to enable the Engineer to verify conformity with the intent of Contract. Drawing shall identify materials and show the details and dimensions of all component parts including plan and elevation, cross section and details. Documents showing conformance with specified sound rating. Design analysis and calculation include design calculations for review of design loads and member profile. Design parameter adopted and their sources.
- (II) Contractor has to develop working drawings for various works which are to be executed under this contract and submit for approval of Engineer well before 15 days w.r.t start of various works. Engineer will approve the submitted working drawings within 07 days of submittal if it is fit for execution otherwise within 05 days of submission return back to contractor with observations. Any delay in submission/alteration of working drawings will be at the cost of contractor. The cost of developing working drawings shall be included in the quoted rate by the tenderer and no additional cost shall be paid to contractor over and above accepted rates.

## PART-I

### CHAPTER-V

#### SPECIAL CONDITIONS OF CONTRACT

##### ADDITIONAL SPECIAL CONDITIONS (SECTION-3)

### 3. GENERAL

- a. Where there is any conflict between the various documents in the contract, the following order of priority shall be followed i.e. a document appearing earlier shall override the document appearing subsequently. However, the ***decision of Engineer/DFCCIL would be final & binding*** in this regard.

Order of Priority of Documents:

1. Letter of Award
2. Schedule of items, Rates & Quantities.
3. Special Conditions of Contract.
4. Technical Specifications as given in tender documents.
5. Drawings, if any.
6. General Conditions of Contract.
7. Relevant BIS Codes

**Note:** Unless otherwise specified, CPWD Specifications with corrections slips till the last date of tender submission shall be followed in general.

- b. The work shall be carried out in accordance with the Architectural drawings and Interior drawings, to be issued from time to time, by the Engineer. Before commencement of any item of work, the contractor shall correlate all the relevant Architectural, Interior drawings issued for the work and satisfy himself that the information available from there is complete and unambiguous and develop working drawings accordingly. The discrepancy, if any, shall be brought to the notice of the Engineer before execution of the work. The contractor alone shall be responsible for any loss or damage occurring by the commencement of work on the basis of any erroneous and or incomplete information.
- c. The contractor shall be responsible for the watch and ward / guard of the buildings, till the building is physically handed over to the DFCCIL. ***No extra payment*** shall be made on this account.
- d. For works below ground level, the contractor shall keep that area free from water. If, dewatering or bailing out of water is required, the contractor shall ***do it at his cost*** and ***nothing extra shall be paid*** except otherwise provided in the items of schedule of quantities.
- e. The Contractor shall make all necessary arrangements for protecting from rains, fog or likewise extreme weather conditions, the work already executed and for carrying out the

further work, during monsoon including providing and fixing temporary shelters, protections etc. ***Nothing extra shall be payable*** on this account. Also, no claims for hindrance shall be entertained on this account.

- f. In case of flooding of site on account of rain or any other cause and any consequent damage, whatsoever, ***no claim financially or otherwise*** shall be entertained notwithstanding any other provisions elsewhere in the contract agreement. Also, the Contractor shall make good, at his own cost, the damages caused, if any. Further, no claims for hindrance shall be entertained on this account.
- g. The contractor will take reasonable precautions to prevent his workmen and employees from removing and damaging any flora (*plant/vegetation*) from the project area.

**h. Emergency Work:**

In the event of any action or failure occurring in on or about the work or arising out of or in connection with the construction, completion or maintenance of the work which in the Engineer opinion requires immediate attention, Engineer may by its own workmen or other agency execute or partly execute the necessary work or carry out repairs if the Engineer considers that the contractor is not in a position to do in time and to charge the cost thereof to the contractor as determined by the Engineer.

**i. Protection & Care of Works:**

- a. The works are to be protected as asked by the Engineer. Protection is required for all hazardous works and during installation, testing & commissioning of work. The cost of safety measures & other gadgets etc. shall be deemed to be included in the quoted rates and ***nothing extra*** shall be paid for the same.
- b. ***Care of the building:***
  - (i) Care shall be taken by the contractor during execution of the work to avoid damage to the building and adjacent buildings.
  - (ii) They shall also be responsible for repairing all such damages and restoring the same to the original finish at their cost.
  - (iii) They shall also remove all unwanted and waste materials arising out of the execution of work from the site from time to time.

**j. TOOLS AND PLANTS**

- (i) The bidder should arrange construction equipments required for the proper and timely execution of the work. ***Nothing extra shall be paid*** on this account.
- (ii) No tools and plants including any special T&P etc. shall be supplied by the Department and the contractor shall have to make his ***own arrangements at his own cost***. No claim of hindrance (*or any other claim*) shall be entertained on this account.

- (iii) The contractor shall do proper sequencing of the various activities by suitably staggering the activities within various floors of the buildings, so as to achieve the early completion. The agency may deploy adequate equipment, machinery and labour as required for the completion of the entire work within the stipulated period specified. Also, ancillary facilities shall be provided by contractor commensurate with requirement to complete the entire work within the stipulated period. ***Nothing extra shall be payable*** on this account. Adequate number/sets of equipment in working condition, along with adequate stand-by arrangements, shall be deployed during entire construction period. It shall be ensured by the Contractor that all the equipment, Tools & Plants, machineries etc. provided by him are maintained in proper working conditions at all times during the progress of the work and till the completion of the work. Further, all the constructional tools, plants, equipment and machineries provided by the contractor, on site of work or his work shop for this work, shall be exclusively intended for use in the construction of this work and they shall not be shifted / removed from site without the permission of the Engineer.

k. **ROYALTY**

- (i) Royalty at the prevalent rates shall be paid by the contractor for any such item or the RMC supplier as per the terms of supply between them, on all materials such as boulders, metals, all sizes stone aggregates, brick aggregates, coarse and fine sand, moorum, river sand, gravels and bajri etc. collected by him for the execution of the work, directly to the revenue authority of the state government concerned. Further, contractor needs to submit proof of submission of full royalty to the state government or local authority. ***Nothing extra shall be payable*** on this account.

l. **PRESERVATION AND CONSERVATION MEASURES**

- (i) Existing drains, pipes, cables, over-head wires, sewer lines, water lines and similar services encountered in the course of the execution of work shall be protected against the damage by the contractor, ***at his own expense***, for which ***nothing is payable***. The contractor shall not store materials or otherwise occupy any part of the site in a manner likely to hinder the operation of such services.
- (ii) All fossils, coins, articles of value of antiquity, structures and other remains or things of geological or archaeological interest discovered on project location during excavation/construction shall be the property of the Government, and shall be dealt with as per provisions of the relevant legislation. The contractor will take reasonable precaution to prevent his workmen or any other persons from removing and damaging any such article or thing. He will, immediately upon discovery thereof and before removal acquaint the Engineer/DFCCIL of such discovery and carry out the official instructions of Engineer/DFCCIL for dealing with the same, till then, all work shall be carried out in a way so as not to disturb/ damage such article or thing.

m. **RESPONSIBILITY**

- (i) The Contractor shall keep himself fully informed of all relevant acts and laws of the Central & State Governments, orders, decrees of statutory bodies, tribunals having any jurisdiction or authority, which in any manner may affect those engaged or employed and anything related to carrying out the work. All the rules & regulations and bye-laws laid down by District Collector /Noida Authority and any other statutory bodies shall be adhered to, by the contractor, during the execution of work. The Contractor shall also adhere to all traffic restrictions notified by the local authorities. ***The water charges (for municipal water connection as well as tanker water) shall be borne by the contractor.*** Also, if the contractor obtains water connection for the drinking purposes from the municipal authorities or any other statutory body, the consequent ***sewerage charges shall be borne by the contractor.*** All statutory taxes, levies, charges (*including water and sewerage charges, charges for temporary service connections and / or any other charges*) payable to such authorities for carrying out the work, ***shall be borne by the Contractor.*** The Contractor shall arrange to give all notices as required by any statutory / regulatory authority and shall pay to such authority all the fees that is required to be paid for the execution of work. He shall protect and indemnify the DFCCIL and its officials & employees against any claim and /or liability arising out of violations of any such laws, ordinances, orders, decrees, by himself or by his employees or his authorized representatives. ***Nothing extra shall be payable*** on these accounts.
- (ii) The fee payable to statutory authorities for obtaining the ***various permanent service connections*** and Building Use Certificate for the building ***shall be borne by the DFCCIL.*** The contractor shall assume all liability, financial or otherwise in connection with this contract and shall protect and indemnify DFCCIL from any and all damages and claims that may arise on any account.
- The Contractor shall indemnify against all claims in respect of patent rights, royalties, design, trademarks of name or other protected rights, damages to adjacent buildings, roads or members of public, in course of execution of work or any other reasons whatsoever, and shall himself defend all actions arising from such claims and shall indemnify the DFCCIL in all respect from such actions, costs and expenses. ***Nothing extra shall be payable*** on this account.
- (iii) The contractor shall keep himself fully informed of all acts and laws of the Central Government and Government of U.P., all local bye laws, ordinances, rules and regulations and all orders and decree of bodies or, tribunals having any jurisdiction or authority which in any manner affect those engaged or employed on the work or which in any way affect the conduct of the works. Contractor shall at all times, observe and comply with all such laws, ordinances, rules, regulations, orders and decrees, and shall give all notices and ***pay out of his own money any fees or charges to which he may be liable.*** He shall protect and indemnify the DFCCIL and its officers and employees against any claim or liability

arising out of violations of any such law, ordinances, legislations, order or decree, whether by himself or by his employees & authorized representatives.

n. **CO-OPERATION WITH OTHER CONTRACTORS/SPECIALIZED AGENCIES/SUB-CONTRACTORS**

- (i) The contractor shall take all necessary precautions to prevent any nuisance or inconvenience to the owners, tenants or occupants of the adjacent properties and to the public in general. The Contractor shall take all care, as not to damage any other adjacent property or other services running adjacent to the plot. If any damage is done, the same shall be made good by the contractor **at his own cost** and to the entire satisfaction of the Engineer. The contractor shall use such methodology and equipment for execution of the work, so as to cause **minimum environmental pollution** of any kind during construction, to have minimum construction time and minimum inconvenience to road users and to the occupants of the buildings on the adjacent plot and public in general, etc. He shall make good **at his own cost** and to the entire satisfaction of the Engineer any damage to roads, paths, cross drainage works or public or private property whatsoever caused, due to the execution of the work or by traffic brought thereon, by the Contractor. Further, the contractor shall take all precautions to abide by the environmental related restrictions imposed by U.P. state Pollution control board, Govt. of U.P. as well as prevent any pollution of streams, ravines, river bed and waterways. All waste or superfluous materials shall be transported by the Contractor, entirely to the satisfaction of the Engineer. Utmost care shall be taken to keep the noise level to the barest minimum so that no disturbance as far as possible is caused to the occupants / users of adjoining buildings. No claim what so ever on account of site constraints mentioned above or any other site constraints, such as distance from Noida city as approximately 20 km, lack of public transport, inadequate availability of skilled, semi-skilled or unskilled workers in the near vicinity, non-availability of construction machinery spare parts and any other constraints not specifically stated here, shall be entertained from the contractor. Therefore, the Tenderers are advised to visit site and get first-hand information of site constraints. Accordingly, they should quote their tenders. **Nothing extra shall be payable** on this account.
- (ii) The contractor shall cooperate with and provide the facilities to the sub-contractors and other agencies working at site for smooth execution of the work. The contractor shall indemnify the DFCCIL against any claim(s) arising out of such disputes. The contractor shall:
  1. Allow use of scaffolding, toilets, sheds etc.
  2. Properly co-ordinate their work with the work of other Contractors.
  3. Provide control lines and benchmarks to his Sub-Contractors and the other Contractors.
  4. Provide electricity and water at mutually agreed rates.
  5. Provide hoist and crane facilities for lifting material at mutually agreed rates.
  6. Co-ordinate with other contractors for leaving inserts, making chases, alignment of

services etc. at site.

7. Adjust work schedule and site activities in consultation with the Engineer and other contractors to suit the overall schedule completion.
  8. Resolve the disputes with other contractors / sub-contractors amicably and the Engineer shall not be made intermediary or arbitrator.
- (iii) The work should be planned in a systematic manner so as to ensure proper co-ordination of various disciplines.
  - (iv) The contractor shall leave recesses, holes, openings trenches etc. as may be required for the related works and ***nothing extra shall be payable*** on this account.
  - (v) The contractor shall conduct his work, so as not to interfere with or hinder the progress or completion of the work being performed by other contractor(s) or by the Engineer and shall as far as possible arrange his work and shall place and dispose of the materials being used or removed so as not to interfere with the operations of other contractor or he shall arrange his work with that of the others in an acceptable and in a proper co-ordination manner and shall perform it in proper sequence to the complete satisfaction of others.
  - (vi) **Specialized Agencies**
    1. The tenderer must associate with himself, agencies of the appropriate eligibility to tender for each of specialized nature of items / work. Such works shall be got executed only through associated agencies specialized in these fields.
    2. It shall be the responsibility of main contractor to sort out any dispute / litigation with the Specialized Agencies without any time & cost overrun to the DFCCIL. The main contractor shall be solely responsible for settling any dispute / litigation arising out of his agreement with the Specialized Agencies. The contractor shall ensure that the work shall not suffer on account of litigation/ dispute between him and the specialized agencies / sub- contractor(s). No claim of hindrance in the work shall be entertained from the Contractor on this account. ***No extension of time*** shall be granted and ***no claim*** what so ever, of any kind, shall be entertained from the Contractor on account of delay attributable to the selection/rejection of the Specialized Agencies.

## vii. RATES

The rates quoted by the contractor are deemed to be inclusive of site clearance, setting out work, profile, setting lay out on ground, establishment of reference bench mark(s), installing various signage, taking spot levels, survey with total station, construction of all safety and protection devices, compulsory use of helmet and safety shoes, and other appropriate safety gadgets by workers, imparting continuous training for all the workers, barriers, preparatory works, construction of clean, hygienic and well ventilated workers housings in sufficient numbers working during monsoon or odd season, working beyond normal hours, working at all depths, height, lead, lift, levels and location etc. and any other unforeseen but essential incidental works required to complete this work. ***Nothing extra shall be payable*** on this account and ***no extension of time*** for completion of work shall be granted on these accounts.

- (viii) No foreign exchange shall be made available by the DFCCIL for importing (*purchase*) of

equipment, plants, machinery, materials of any kind or any other items required to be carried out during execution of the work. ***No delay and no claim*** of any kind shall be entertained from the Contractor, on account of ***variation in the foreign exchange rate***.

- (ix) All ancillary and incidental facilities required for execution of work like labour camp, stores, fabrication yard, offices for Contractor, watch and ward, temporary ramp required to be made for working at the basement level, temporary structure for plants and machineries, water storage tanks, installation and consumption charges of temporary electricity, telephone, water etc. required for execution of the work, liaison and pursuing for obtaining various No Objection Certificates, completion certificates from local bodies etc., protection works, testing facilities / laboratory at site of work, facilities for all field tests and for taking samples etc. during execution or any other activity which is necessary ***(for execution of work and as directed by Engineer)***, ***shall be deemed to be included in rates quoted by the Contractor***, for various items in the schedule of quantities. ***Nothing extra shall be payable*** on these accounts. Before start of the work, the Contractor shall submit to the Engineer, a site / construction yard layout, specifying areas for construction, site office, positioning of machinery, material yard, cement and other storage, steel fabrication yard, site laboratory, water tank, etc. ***DFCCIL shall provide rent free piece of land*** for construction of these facilities at construction site for the duration of this work.
- (x) For completing the work in time, the contractor might be required to work in two or more shifts ***(including night shifts)***. ***No claim*** whatsoever shall be entertained on this account, not with-standing the fact that the contractor may have to pay extra amounts for any reason, to the labourers and other staff engaged directly or indirectly on the work according to the provisions of the labour and other statutory bodies regulations and the agreement entered upon by the contractor with them.
- (xi) All material shall only be brought at site as per program finalized with the Engineer/DFCCIL. ***Any pre-delivery of the material*** not required for immediate consumption shall not be accepted and ***thus not paid for***.

**o. SAFETY PRACTICES**

- (i) **WARNING / CAUTION BOARDS:** All temporary warning / caution boards / glow signage display such as "Construction Work in Progress, "Keep Away", "No Parking", Diversions & protective Barricades etc. shall be provided and displayed during day time by the Contractor, wherever required and as directed by the Engineer. These glow signages and red lights shall be suitably illuminated during night also. The Contractor shall be solely responsible for damage and accident caused, if any, due to negligence on his part. Also, he shall ensure that no hindrance, as far as possible, is caused to general traffic during execution of the work. This signage shall be dismantled & taken away by the Contractor after the completion of work, only after approval of the Engineer. ***Nothing extra shall be payable*** on this account.



- (ii) **SIGN BOARDS:** The contractor shall provide and erect a display board of size and shape as required and paint over it, in a legible and workman like manner, the details about the salient features of the project, as required by the Engineer. The Contractor shall fabricate and put up a sign board in an approved location and to an approved design indicating name of the project, client / owner, architects, structural consultants etc. besides providing space for names of other Contractors, Sub-Contractors and specialized agencies. ***Nothing extra shall be payable*** on this account.
- (iii) Necessary protective and safety equipment shall be provided to the Site Engineer, Supervisory staff, labour and technical staff of the contractor by the contractor ***at his own cost*** and to be used at site.
- (iv) No inflammable materials including P.O.L shall be allowed to be stored in huge quantity at site. Only limited quantity of P.O.L may be allowed to be stored at site subject to the compliance of all rules/instructions issued by the relevant authorities and as per the direction of Engineer in this regard. Also, all precautions and safety measures shall be taken by the contractor for safe handling of the P.O.L products stored at site. All consequences on account of unsafe handling of P.O.L ***shall be borne by the Contractor***.

**p. QUALITY ASSURANCE**

- (i) The proposed building is a prestigious project of DFCCIL and quality of work is of paramount importance. Contractor shall have to engage well-experienced skilled labour and deploy modern T&P and other equipment to execute the work. Many items like exposed finish form work, specialized flooring work, Polysulphide/P.U. sealant and backer rod fixing in expansion joints, factory made door- window shutters, proper slope maintaining in toilet units, sanitary- water supply installation, textured finishing, grit plastering with aluminium channel insertions, water proofing treatment, Extruded Polystyrene insulation boards, façade works and chemical treatment in toilet drops will specially require engagement of skilled workers having experience particularly in execution of such items.
- (ii) The contractor shall ensure quality construction in a planned and time bound manner. Any sub-standard material/work beyond set out tolerance limit ***shall be summarily rejected*** by the Engineer & contractor shall be bound to replace / remove such sub-standard/defective work immediately. If any material, even though approved by Engineer is found defective or not conforming to specifications shall be replaced/removed by the contractor ***at his own risk & cost***.
- (iii) The contractor shall submit, a detailed and complete method statement for the execution, testing and Quality Assurance, of such items of works, as directed by the Engineer. All the materials to be used in the work, to give the finished work complete in all respects, shall comply with the requirements of the specifications and shall pass all the tests required as per specifications as applicable or such specifications / standards as directed by the Engineer. However, keeping the Quality Assurance in mind, the Contractor shall submit, on request from the Engineer, his own Quality Assurance procedures for basic materials and such items, to be followed during the execution of the work, for approval of the Engineer.
- (iv) All materials and fittings brought by the contractor to the site for use shall conform to

the samples approved by the Engineer which shall be preserved till the completion of the work. If a particular brand of material is specified in the item of work in Schedule of Quantity, the same shall be used after getting the same approved from Engineer. Wherever brand/quality of material is not specified in the item of work, the contractor shall submit the samples as per suggested list of brand names given in the tender document/SCC for approval of Engineer. For all other items, materials and fittings of ISI Marked shall be used with the approval of Engineer.

- (v) Wherever ISI Marked material / fittings are not available, the contractor shall submit samples of materials / fittings manufactured by firms of repute conforming to relevant specifications or IS codes and use the same only after getting the approval of Engineer.
- (vi) The contractor shall procure and provide all the materials from the manufacturers / suppliers as per the list attached with the tender documents/SCC, as per the item description of the work. The equivalent brand for any item shall be permitted to be used in the work, only after approval of Engineer/DFCCIL. **No claim**, whatsoever, of any kind **shall be entertained** from the contractor on this account and **Nothing extra shall be payable** on this account.
- (vii) All materials whether obtained from Govt. stores or otherwise shall be got checked by the Engineer or his authorized supervisory staff on receipt of the same at site before use.
- (viii) The tests, as necessary, shall be conducted in the laboratory approved by the Engineer/DFCCIL. The samples shall be taken for carrying out all or any of the tests stipulated in the specifications and as directed by the Engineer/DFCCIL or his authorized representative.
- (ix) All the registers of tests carried out at Construction Site or in outside laboratories and all material at site (MAS) registers including cement register shall be maintained by the contractor. All the entries in the registers will be made by the designated Engineering Staff of the contractor and same should be regularly reviewed by Engineer/Employer. Contractor shall be responsible for safe custody of all the test registers.
- (x) The contractor shall at his own risk and cost make all arrangements and shall provide all such facilities including material and labour, the Engineer/DFCCIL may require for collecting, preparing, forwarding the required number of samples for testing as per the frequency of test stipulated in the contract specifications or as considered necessary by the Engineer/DFCCIL, at such time and to such places, as directed by the Engineer/DFCCIL. **Nothing extra shall be payable** for the above.
- (xi) The contractor or his authorized representative shall associate in collection, preparation, forwarding and testing of such samples. In case he or his authorized representative is not present or does not associate him, the result of such tests and consequences thereon shall be binding on the contractor. The contractor or his authorized representative shall remain in contact with the Engineer or his authorized representative associated for all such operations. No claim of payment or claim of any other kind, whatsoever, shall be entertained from the contractor.
- (xii) **All the testing charges shall be borne by the contractor.**
- (xiii) All the hidden items such as water supply lines, drainage pipes, conduits, sewers etc. are to

be properly tested as per the design conditions before covering and their measurements in computerized measurement book duly test checked shall be deposited with Engineer or his authorized representative, prior to hiding these items.

- (xiv) Water tanks, taps, sanitary, water supply and drainage pipes, fittings and accessories should conform to byelaws and municipal body / Corporation/Authority where CPWD Specifications are not available.
- (xv) The contractor shall give performance test of the entire installation(s) as per the standing specifications before the work is finally accepted and ***nothing extra*** whatsoever ***shall be payable*** to the contractor for the test.
- (xvi) ***The contractor shall have to execute guarantee bonds in respect of water proofing / anti termite treatment works as per Proforma enclosed.***
- (xvii) The contractor shall depute Site Engineer & skilled workers as required for the work. He shall submit organization chart along with details of Engineers and supervisory staff. It shall be ensured that all decision-making powers shall be available to the representatives of the contractor at site itself to avoid any likely delays on this account. The contractor shall also furnish list of persons for specialized works to be executed for various items of work. The contractor shall identify and deploy key persons having qualifications and experience in the similar and other major works, as per the field of their expertise. If during the course of execution of work, the Engineer is of the opinion that the deployed staff is not sufficient or not well experienced; the Contractor shall deploy more staff or better- experienced staff at site to complete the work with quality and in stipulated time limit.
- (xviii) The contractor shall maintain all the work in good condition till the completion of entire work. The contractor shall be responsible for and shall make good, all damages and repairs, rendered necessary due to fire, rain, traffic, floods or any other causes. The Engineer shall not be responsible for any claims for injuries to person/workmen or for structural damage to property happening from any neglect, default, want of proper care or misconduct on the part of the contractor or of any other of his representatives, in his employment during the execution of the work. The compensation, if any, shall be paid directly to the Department / authority / persons concerned, by the Contractor ***at his own cost.***
- (xix) The contractor shall ***arrange electricity at his own cost*** for testing of the various electrical installations as directed by Engineer and for the consumption by the contractor for executing the work. Also, all the ***water required*** for testing various electrical installations, fire pumps, wet riser / fire-fighting equipment, fire sprinklers etc. and also testing water supply, sanitary and drainage lines, water proofing of underground sump, overhead tanks, water proofing treatment etc. shall be arranged ***by the contractor at his own cost. Nothing extra shall be payable*** on this account.

#### q. SUBMISSION AND DOCUMENTATION

- (i) The contractor shall display all permissions, licenses, registration certificates, bar charts, other statements etc. under various labour laws and other regulations applicable to the works, at his site office.
- (ii) The contractor shall make available computerized Standard Measurement Book (SMBs) having

measurement of all the permanent standing in a building.

- (iii) The contractor will submit computerized measurement sheet for the work carried out by him for making payment. For casting of RCC members and other hidden items the corrected and duly test checked measurement sheets of reinforcement or that of other hidden items shall be deposited with Engineer or his authorized representative, before casting of RCC or other hidden items. The delay in submission of corrected and duly checked measurement sheet may, therefore, delay casting of RCC or execution of hidden item for which no hindrance shall be recorded.
- (iv) To avoid delay, contractor should submit all samples well in advance so as to give timely orders for procurement.

#### r. **CLEANLINESS OF SITE**

- (i) The contractor shall not stack building material / malba / muck on the land or road of the local development authority or on the land owned by the others, as the case may be. So, the muck, rubbish etc. shall be removed periodically as directed by the Engineer, from the site of work to the approved dumping grounds as per the local byelaws and regulations of the concerned authorities and all necessary permissions in this regard from the local bodies shall be obtained by the contractor. ***Nothing extra shall be payable*** on this account.

In case, the contractor is found stacking the building material / malba as stated above, the ***contractor shall be liable to pay*** the stacking charges / ***penalty*** as may be levied by the local body or any other authority and also to face penal action as per the rules, regulations and bye-laws of such body or authority. ***The Engineer shall be at liberty to recover***, such sums due but not paid to the concerned authorities on the above counts, from any sums due to the contractor including amount of the Security Deposit and performance guarantee in respect of this contract agreement.

- (ii) The contractor shall take instructions from the Engineer regarding collection and stacking of materials at any place. No excavated earth or building rubbish shall be stacked on areas where other buildings, roads, services and compound walls are to be constructed.
- (iii) The site of work shall be always kept clean due to constraints of space and to avoid any nuisance to the users of buildings in the adjacent plots. The contractor shall take all care to prevent any water- logging at site. The waste water, slush etc. shall not be allowed to be collected at site. It may be directly pumped into the creek with prior approval of the concerned authorities. For discharge into public drainage system, necessary permission shall be obtained from relevant authorities after paying the necessary charges, if any, directly to the authorities. The work shall be carried out in such a way that the area is kept clean and tidy. ***All the fees/charges in this regard shall be borne by the Contractor. Nothing extra shall be payable*** on this account.

#### **INSPECTION OF WORK**

- (i) In addition to the provisions of relevant clauses of the contract, the work shall also be open to inspection by the CGM, and other senior officers of DFCCIL in addition of the

Architect, Engineer and his authorized representative. The contractor shall at times during the usual working hours and at all times at which reasonable notices of the intention of the Architect/Engineer/DFCCIL or other officers as stated above to visit the works shall have been given to the contractor, either himself be present to receive the orders and instructions or have a responsible representative duly accredited in writing, to be present for that purpose.

**t. SETTING OUT**

- (i) The contractor shall carry out *survey* of the work area, ***at his own cost, setting out*** the layout of building in consultation with the Engineer & proceed further. Any discrepancy between the architectural drawings and actual layout at site shall be brought to the notice of the Engineer. It shall be responsibility of the contractor to ensure correct setting out of alignment. Total station survey instruments only shall be used for layout, fixing boundaries, and center lines, etc., along with theodolites. ***Nothing extra shall be payable*** on this account.
- (ii) The contractor shall establish, maintain and assume responsibility for grades, lines, levels and benchmarks. He shall report any errors or inconsistencies regarding grades, lines, levels, dimensions etc. to the Engineer before commencing work. Commencement of work shall be regarded as the Contractor's acceptance of such grades, lines, levels, and dimensions and no claim shall be entertained at a later date for any errors found.
- (iii) If at any time, any error appears due to grades, lines, levels and benchmarks during the progress of the work, the contractor shall, at his own expense rectify such error, if so required, to the satisfaction of the Engineer. ***Nothing extra shall be payable*** on this account.
- (iv) Though the site levels are indicated in the drawings the contractor shall ascertain and confirm the site levels with respect to benchmark from the concerned authorities. The contractor shall protect and maintain temporary/permanent benchmarks at the site of work throughout the execution of work. These benchmarks shall be got checked by the Engineer or his authorized representatives. The work at different stages shall be checked with reference to bench marks maintained for the said purpose. ***Nothing extra shall be payable*** on this account.
- (v) The approval by the Engineer, of the setting out by the contractor, shall not relieve the contractor of any of his responsibilities and obligation to rectify the errors/defects, if any, which may be found at any stage during the progress of the work or after the completion of the work.
- (vi) The contractor shall be entirely and exclusively responsible for the horizontal, vertical and other alignments, the level and correctness of every part of the work and shall rectify effectively any errors or imperfections therein. Such rectifications shall be carried out by the contractor ***at his own cost*** to the entire satisfaction of the Engineer.

**u. RECESS, HOLES, OPENINGS, ETC**

The contractor shall leave such recesses, holes, openings, etc. as may be required for the electric, air-conditioning and other related works for which inserts, sleeves, brackets, conduits, base plates, clamps etc. and the contractor shall fix the same at the time of casting of concrete, stone work & brick work or at any similar location if required, and ***nothing extra shall be payable*** on this account.

v. **JURISDICTION OF COURT**

Courts at Delhi/Noida alone shall have the jurisdiction to decide any dispute arising out of or in respect of this contract.

w. **ALL HEIGHTS, LIFTS, LEADS AND DEPTHS**

Unless otherwise provided in the Schedule of quantities or in CPWD Specifications or in tender document, the rates tendered by the contractor shall be ***all inclusive (except GST)*** and shall apply to all heights, lifts, leads and depths of the building and nothing extra shall be payable to him on this account.

x. **PREVENTION OF NUISANCE AND POLLUTION CONTROL**

The contractor shall take all necessary precautions to prevent any nuisance or inconvenience to the owners, tenants or occupiers of adjacent properties and to the public in general and to prevent any damage to such properties from pollutants like smoke, dust, noise. The contractor shall use such methodology and equipment so as to cause minimum environmental pollution of any kind during and minimum hindrance to road users and to occupants of the adjacent properties or other services running adjacent/near vicinity. The contractor shall make good at his cost and to the satisfaction of the Engineer, any damage to roads, paths, cross drainage works or public or private property whatsoever caused due to the execution of the work or by traffic brought thereon by the contractor. All waste or superfluous materials shall be carried away by the contractor, without any reservation, entirely to the satisfaction of the Engineer.

y. **SCAFFOLDING**

Wherever required for the execution of work, all the scaffolding shall be provided and suitably fixed by the contractor. It shall be provided strictly with steel double scaffolding system, suitably braced for stability, with all the accessories, gangways, etc. with adjustable suitable working platforms to access the areas with ease for working and inspection. It shall be designed to take all incidental loads. It should cater to the safety features for workmen. ***Nothing extra shall be payable*** on this account. It shall be ensured that no damage is caused to any structure due to the scaffolding.

z. **PRODUCT DELIVERY, STORAGE AND HANDLING OF CHEMICALS**

- (i) The contractor shall construct storage space for Chemicals materials to ensure that the storage conditions are as recommended by the manufactures.
- (ii) All the materials shall be procured and delivered in sealed containers with labels legible and intact.

- (iii) All the chemicals {polymers, epoxy, water proofing compound, plasticizer, Polysulphide, SBR based elastomeric, APP (Atactic Polypropylene Polymer), all exterior and interior paints, polish etc.} shall be procured in convenient packs say 20 litres/Kgs. capacity packing only or as approved by the Engineer, and not in bigger capacity containers, say 200 litre (Kgs.) drums unless otherwise specifically permitted by the Engineer. One sample from each lot of the chemical procured by the contractor shall be tested in a laboratory as approved by the Engineer.
- (iv) All material required for the execution of the work shall be got approved, procured and deposited with the Contractor's supervisory staff. The watch and ward of such material shall, however, remain to be the responsibility of the contractor and no claim, whatsoever, on this account shall be entertained. Different containers of each chemical shall be serially numbered on packing and also consumed in that order. Day- to-Day account of receipt, issue and balance shall be regulated by the Contractor and proper account shall be maintained at site of work in the prescribed form as per the standard practice.
- (v) All the chemicals shall be procured by the contractor directly from the manufacturer. In exceptional circumstances, the contractor may be allowed to procure the materials from the authorized dealers of the manufacturers.
- (vi) The original copies of challan/cash memos towards the quantity of various chemicals procured shall be made available by the contractor at the request from the Engineer-and a copy of the same shall be kept in record.
- (vii) The Name of manufacturers, manufacturer's product identification, manufacturer's mixing instructions, warning for handling and toxicity and date of manufacturing and shelf life shall be clearly and legibly mentioned on the labels of each container.
- (viii) The contractor shall submit for the chemicals procured, manufacturer's and / or authorized dealer's certificate regarding supplying and verifying conformance to the material specifications, as specified.
- (ix) All filled containers shall be handled in safe manner and in a way to avoid breaking container seals.
- (x) All arrangements for measuring, dosing and mixing of material / chemicals at site have to be made by the contractor.
- (xi) Contractor shall suitably advise his site Engineer and all the workers as regards safe handling of chemicals. Necessary protective and safety equipment in form of hand gloves, goggles etc. shall be provided by the contractor and be also used at site.
- (xii) All incidental charges of any kind including cartage, storage and wastage and safe custody of material etc. shall be borne by the contractor and no claim, whatsoever, shall be entertained on this account.
- (xiii) The chemicals shall be tested in an independent laboratory as approved by the Engineer at the frequency as specified. If required, more samples may have to be tested as per the directions of the Engineer. ***Nothing extra shall be payable*** on this account.

## **PART-I CHAPTER-V**

### **SPECIAL CONDITIONS OF CONTRACT**

#### **METHODOLOGIES FOR GREEN BUILDINGS (SECTION-4)**

- 4.1 To secure at least **5-Star GRIHA** ratings, a high degree of responsibility and cooperation is necessary from the contractor employed.
- 4.2 The following guideline provides the general concept of green, green building rating and the expectations from each one of those involved in this project:

#### **4.3 GENERAL NOTE ON GREEN BUILDING PRACTICES**

All materials and systems used in the project are intended to maximize energy efficiency for operation of Project throughout service life (*substantial completion to ultimate disposition – reuse, recycling, or demolition*) with an emphasis on top quality. Materials and systems are to maximize environmentally-benign construction techniques, including construction waste recycle, reusable delivery packaging, and reusability of selected materials. All vendors / contractors must adhere to best practices related to Green Buildings. Other than the particular specifications / methodologies for green buildings outlined here, all vendors / contractors will be furnished with a supplementary set of guidelines more specific to their nature of service/product.

#### **4.4 GREEN BUILDING PRACTICES:**

- 4.4.1 Ensure healthy indoor air quality in final Project.
- 4.4.2 Maximize use of products with low embodied energy (*harvesting, mining, manufacturing, transport, installation, use, operations, recycling and disposal*). Exceptions might include materials that result in net energy conservation during their useful life in building and building's life cycle.
- 4.4.2.1 Where possible, select materials harvested and manufactured regionally, within a 800-km radius of the project site.
- 4.4.2.2 Maximize use of durable products.
- 4.4.2.3 Maximize use of products easy to maintain, repair, and that can be cleaned using non-toxic substances.
- 4.4.2.4 Maximize recycled content in materials, products, and systems.
- 4.4.2.5 Maximize use of reusable and recyclable packaging.
- 4.4.2.6 Where possible and feasible, provide for non-destructive removal and re-use of materials after their service life in this building.
- 4.4.3 Re-use existing building materials to extent feasible within design concept expressed in Contract Documents. Provide materials that utilize recycled content to maximum degree possible without being detrimental to product performance or indoor air quality.



- 4.4.4 Use construction practices such as material waste reduction and dimensional planning that maximize efficient use of resources and materials.
- 4.4.5 Provide or contribute to O&M Manuals wherever applicable.
- 4.4.6 Be conversant with the Site Waste Management Program Manual and actively contribute to its compilation. Assist the Engineer by estimating the nature and volume of waste generated by the process/installation in question.
- 4.4.7 Minimize pollution: Select materials that generate least amount of pollution during mining, manufacturing, transport, installation, use, and disposal.
  - 4.4.7.1 Avoid materials that emit greenhouse gases
  - 4.4.7.2 Avoid materials that require energy intensive extraction, manufacturing, processing, transport, installation, maintenance, or removal.
  - 4.4.7.3 Avoid materials that contain ozone-depleting chemicals (*e.g. CFCs or HCFCs*).
  - 4.4.7.4 Avoid materials that emit potentially harmful volatile organic chemicals (VOCs).
  - 4.4.7.5 Employ construction practices that minimize dust production and combustible by-products.
  - 4.4.7.6 Avoid materials that can leach harmful chemicals into ground water; do not allow potentially harmful chemicals to enter sewers or storm drains.
  - 4.4.7.7 Protect soil against erosion by wind or storm-water and topsoil depletion.
  - 4.4.7.8 Minimize noise generation during construction; screen mechanical equipment to block noise.
  - 4.4.7.9 Select materials that can be reused or recycled and materials with significant percentage of recycled content; conform with or exceed specified Project recycled content percentages for individual materials; avoid materials difficult to recycle. Protect natural habitats; restore natural habitats where feasible within scope of Project.

## PART-I CHAPTER-V

### SPECIAL CONDITIONS OF CONTRACT

#### CONDITIONS OF CONTRACT SPECIFIC TO GREEN BUILDING PRACTICES (SECTION-5)

**5.0** The contractor shall strictly adhere to the following conditions as part of his contractual obligations as the project is targeted to get **5-Star GRIHA** ratings certification:

#### **5.1 SITE**

- 5.1.1 The contractor shall ensure that adequate measures are taken for the prevention of erosion of the top soil during the construction phase. The contractor shall implement the Erosion and Sedimentation Control Plan (ESCP) provided to him by the GRIHA Consultant / Architect / Engineer/DFCCIL as part of the larger Construction Management Plan (CMP). The contractor shall obtain the Erosion and Sedimentation Control Plan (ESCP) Guidelines from the Landscape Architect and then prepare “working plan” for the following month’s activities as a CAD drawing showing the construction management, staging & ESCP. At no time, soil should be allowed to erode away from the site and sediments should be trapped where necessary.
- 5.1.2 The contractor shall ensure that all the top soil excavated during construction works is neatly stacked and is not mixed with other excavated earth. The contractors shall take the clearance of the architects / landscape consultant / green building Consultant/Engineer/DFCCIL before any excavation. Top soil should be stripped to a depth of approximately 20 cm (*centimetres*) from the areas to be disturbed, for example proposed area for buildings, roads, paved areas, external services and area required for construction activities etc. It shall be stockpiled within the plot area only to a maximum height of 40 cm in designated areas, covered or stabilized with temporary seeding for erosion prevention. This stockpiled soil in the end shall be reapplied to site during plantation of the proposed vegetation. Top soil shall be separated from subsoil, debris and stones larger than 50 mm (*millimetre*) diameter.
- 5.1.3 The contractor shall carry out the recommendations of the soil test report for improving the soil under the guidance of the landscape consultant who would also advise on the timing of application of fertilizers and warn about excessive nutrient levels.
- 5.1.4 The contractor shall carry out post-construction placement of topsoil or other suitable plant material over disturbed lands to provide suitable soil medium for vegetative growth. Prior to spreading the topsoil, the sub-grade shall be loosened to a depth of 50mm to permit bonding. Topsoil shall be spread uniformly at a minimum compacted depth of 50mm on grade 1:3 or steeper slopes, a minimum depth of 100mm on shallower slopes. A depth of 300mm is preferred on relatively flatter land.
- 5.1.5 The Contractor should follow the construction plan as proposed by the architect / landscape Consultant/Engineer/DFCCIL to minimize the site disturbance such as soil pollution due to spilling. Use staging and spill prevention and control plan to restrict the spilling of the contaminating material on site. Protect top soil from erosion by collection storage and reapplication of top soil, constructing sediment basin, contour trenching, mulching etc.
- 5.1.6 The barricading by sheets of the construction area shall be done as per direction of Engineer/DFCCIL.

- 5.1.7 The contractor shall not change the natural gradient of the ground unless specifically instructed by the architects / landscape consultant. This shall cover all natural features like water bodies, drainage gullies, slopes, mounds, depressions, rocky outcrops, etc. Existing drainage patterns through or into any preservation area shall not be modified unless specifically directed by the Landscape Architect / Architect/ Engineer.
- 5.1.8 The contractor shall not carry out any work which results in the blockage of natural drainage.
- 5.1.9 The contractor shall ensure that existing grades of soil shall be maintained around existing vegetation and lowering or raising the levels around the vegetation is not allowed unless specifically directed by the landscape architect/architect/Engineer.
- 5.1.10 Contractor shall reduce pollution and land development impacts from automobiles use during construction.
- 5.1.11 Overloading of trucks is unlawful and creates erosion and sedimentation problems, especially when loose materials like stone dust, excavated earth, sand etc. are moved. Proper covering must take place. No overloading shall be permitted.

## 5.2 CONSTRUCTION PHASE AND WORKER FACILITIES

- 5.2.1 The contractor shall specify and limit construction activity in pre-planned/designated areas and shall start construction work after securing the approval for the same from the Engineer/DFCCIL. This shall include areas of construction, storage of materials, and material and personnel movement.
- 5.2.2 Preserve and Protect Landscape during Construction
- 5.2.3 The contractor shall ensure that no trees, existing or otherwise, shall be harmed and damage to roots should be prevented during trenching, placing backfill, driving or parking heavy equipment, dumping of trash, oil, paint, and other materials detrimental to plant health. These activities should be restricted to the areas outside of the canopy of the tree, or, from a safe distance from the tree/plant by means of barricading. Trees will not be used for support; their trunks shall not be damaged by cutting and carving or by nailing posters, advertisements or other material. Lighting of fires or carrying out heat or gas emitting construction activity within the ground, covered by canopy of the tree is not to be permitted.
- 5.2.4 The contractor shall take steps to protect trees or saplings identified for preservation within the construction site have to be protected using tree guards as per Engineer/DFCCIL. ***Nothing extra shall be payable*** on this account.
- 5.2.5 The contractor shall conserve existing natural areas and restore damaged areas to provide habitat and promote biodiversity. Contractor should limit all construction activity within the specified area as per the Construction Management Plan (CMP) proposed by the architect / Landscape consultant/Engineer. All the existing trees should be preserved, if not possible than compensate the loss by re-planting trees in the proportion of 1:3.
- 5.2.6 The contractor shall avoid cut and fill in the root zones, through delineating and fencing the drip line (*the spread limit of a canopy projected on the ground*) of all the trees or group of trees. Separate the zones of movement of heavy equipment, parking, or excessive foot

traffic from the fenced plant protection zones.

- 5.2.7 Maintenance activities shall be performed as needed to ensure that the vegetation remains healthy. The preserved vegetated area shall be inspected by the Landscape Architect / Architect / Engineer/DFCCIL at regular intervals so that they remain undisturbed.
- 5.2.8 Contractor shall be required to develop and implement a waste management plan, quantifying material diversion goals. He shall establish goals for diversion from disposal in landfills and incinerators and adopt a construction waste management plan to achieve these goals. A project-wide policy of “Nothing leaves the Site” should be followed. In such a case when strictly followed, care would automatically be taken in ordering and timing of materials such that excess doesn’t become “waste”. The Contractor’s ingenuity is especially called towards meeting GRIHA 5 Star Rating requirement.
- 5.2.9 Consider recycling cardboard, metal, brick, acoustical tile, concrete, plastic, clean wood, glass, gypsum wallboard, carpet and insulation. Designate a specific area(s) on the construction site for segregated or collection of recyclable material, and track recycling efforts throughout the construction process. Identify construction haulers and recyclers to handle the designated materials. Note that diversion may include donation of materials to charitable organizations and salvage of materials on-site.
- 5.2.10 Contractor shall collect all construction waste generated on site. Segregate these wastes based on their utility and examine means of sending such waste to manufacturing units which use them as raw material or other site which require it for specific purpose. Typical construction debris could be broken bricks, steel bars, broken tiles, spilled concrete and mortar etc.
- 5.2.11 The contractor shall comply with the safety procedures, norms and guidelines (*as applicable*) as outlined in the document Part 7, Constructional Management Practices and Safety, National Building Code of India (NBC) 2016 issued by Bureau of Indian Standards which has safety measures for different construction activities.
- 5.2.12 The contractor shall provide clean drinking water for all workers
- 5.2.13 The contractor shall provide the minimum level of sanitation and safety facilities for the workers at site. The contractor shall ensure cleanliness of workplace with regard to the disposal of waste and effluent; provide clean drinking water and latrines and urinals as per applicable standard. Adequate toilet facilities shall be provided for the workman within easy access of their place of work. The total no. to be provided shall not be less than 1 per 30 employs in any one shift. Toilet facilities shall be provided from the start of building operations, connection to a sewer shall be made as soon as practicable. Every toilet shall be so constructed that the occupant is sheltered from view and protected from the weather and falling objects. Toilet facilities shall be maintained in a sanitary condition. A sufficient quantity of disinfectant shall be provided. Natural or artificial illumination shall be provided.
- 5.2.14 The contractor shall ensure that air pollution due to dust/generators is kept to a minimum, preventing any adverse effects on the workers and other people in and around the site. The contractor shall ensure proper screening, covering stockpiles, covering brick and loads of dusty materials, wheel-washing facility, gravel pit, and water spraying. Contractor shall ensure the following activities to prevent air pollution during construction:

- 5.2.14.1 Clear vegetation only from areas where work will start right away
- 5.2.14.2 Vegetate / mulch areas where vehicles do not ply.
- 5.2.14.3 Apply gravel / landscaping rock to the areas where mulching / paving is impractical
- 5.2.14.4 Identify roads on-site that would be used for vehicular traffic. Upgrade vehicular roads (*if these are unpaved*) by increasing the surface strength by improving particle size, shape and mineral types that make up the surface & base. Add surface gravel to reduce source of dust emission. Limit amount of fine particles (*smaller than 0.075mm*) to 10 – 20%
- 5.2.14.5 Water spray, through a simple hose for small projects, to keep dust under control. Fine mists should be used to control fine particulate. However, this should be done with care so as not to waste water. Heavy watering can also create mud, which when tracked onto paved public roadways, must be promptly removed. Also, there must be an adequate supply of clean water nearby to ensure that spray nozzles don't get plugged. Water spraying can be done on:
  - 5.2.14.6 Any dusty materials before transferring, loading and unloading
  - 5.2.14.7 Area where demolition work is being carried out
  - 5.2.14.8 Any un-paved main haul road
  - 5.2.14.9 Areas where excavation or earth moving activities are to be carried out
    - a) The contractor shall ensure that the speed of vehicles within the site is limited to 10 km/hr.
    - b) All material storages should be adequately covered and contained so that they are not exposed to situations where winds on site could lead to dust / particulate emissions.
    - c) Spills of dirt or dusty materials will be cleaned up promptly so the spilled material does not become a source of fugitive dust and also to prevent of seepage of pollutant laden water into the ground aquifers. When cleaning up the spill, ensure that the clean-up process does not generate additional dust. Similarly, spilled concrete slurries or liquid wastes should be contained / cleaned up immediately before they can infiltrate into the soil / ground or runoff in nearby areas
    - d) Provide hoardings of not less than 3m high along the site boundary, next to a road or other public area
    - e) Provide dust screens, sheeting or netting to scaffold along the perimeter of the building
    - f) Cover stockpiles of dusty material with impervious sheeting
    - g) Cover dusty load on vehicles by impervious sheeting before they leave the site
- 5.2.15 Contractor shall be required to provide an easily accessible area that serves the entire building and is dedicated to the separation, collection and storage of materials for recycling

including (*at a minimum*) paper, corrugated cardboard, glass, plastics, and metals. He shall coordinate the size and functionality of the recycling areas with the anticipated collections services for glass, plastic, office paper, newspaper, cardboard, and organic wastes to maximize the effectiveness of the dedicated areas. Consider employing cardboard balers, aluminum can crushers, recycling chutes, and collection bins at individual workstations to further enhance the recycling program.

- 5.2.16 The contractor shall ensure that no construction leach ate (*Ex: cement slurry*), is allowed to percolate into the ground. Adequate precautions are to be taken to safeguard against this including, reduction of wasteful curing processes, collection, basic filtering and reuse. The contractor shall follow requisite measures for collecting drainage water run-off from construction areas and material storage sites and diverting water flow away from such polluted areas. Temporary drainage channels, perimeter dike/swale, etc. shall be constructed to carry the pollutant-laden water directly to the treatment device or facility (*municipal sewer line*).
- 5.2.17 Staging (*dividing a construction area into two or more areas to minimize the area of soil that will be exposed at any given time*) should be done to separate undisturbed land from land disturbed by construction activity and material storage.
- 5.2.18 Comply with the safety procedures, norms and guidelines (*as applicable*) as outlined in the document Part 7 Constructional Management Practices and Safety, NBC 2016 issued by Bureau of Indian Standards. A copy of all pertinent regulations and notices concerning accidents, injury and first-aid shall be prominently exhibited at the work site. Depending upon the scope & nature of work, a person qualified in first-aid shall be available at work site to render and direct first-aid to casualties. A telephone may be provided to first-aid assistant with telephone numbers of the hospitals displayed. Complete reports of all accidents and action taken thereon shall be forwarded to the competent authorities.
- 5.2.19 Adopt additional best practices, prescribed norms as in Doc No. CED 46(6086), July 2003: NBC 2016: Part 7 Constructional Management Practices and Safety issued by Bureau of Indian Standards
- 5.2.20 The storage of material shall be as per standard good practices as specified in Part 7, Section 2 - Storage, Stacking and Handling practices, NBC 2016 and shall be to the satisfaction of the Engineer to ensure minimum wastage and to prevent any misuse, damage, inconvenience or accident. Watch and ward of the Contractor's materials shall be his own responsibility. There should be a proper planning of the layout for stacking and storage of different materials, components and equipment with proper access and proper maneuverability of the vehicles carrying the materials. While planning the layout, the requirements of various materials, components and equipment at different stages of construction shall be considered. The Employer/Engineer/DFCCIL shall not take any responsibility on any account.
- 5.2.21 The contractor shall ensure the following activities for construction workers safety, among other measures:
  - 5.2.21.1 Guarding all parts of dangerous machinery.
  - 5.2.21.2 Precautionary signs for working on machinery
  - 5.2.21.3 Maintaining hoists and lifts, lifting machines, chains, ropes, and other lifting tackles in

good condition.

- 5.2.21.4 Durable and reusable formwork systems to replace timber formwork and ensure that formwork where used is properly maintained.
- 5.2.21.5 Ensuring that walking surfaces or boards at height are of sound construction and are provided with safety rails or belts.
- 5.2.21.6 Provide protective equipment; helmets etc.
- 5.2.21.7 Provide measures to prevent fires. Fire extinguishers and buckets of sand to be provided in the fire-prone area and elsewhere.
- 5.2.21.8 Provide sufficient and suitable light for working during night time.
- 5.2.22 The contractor shall provide for adequate number of garbage bins around the construction site and the workers facilities and will be responsible for the proper utilization of these bins for any solid waste generated during the construction. The contractor shall ensure that the site and the workers facilities are kept litter free. Separate bins should be provided for plastic, glass, metal, biological and paper waste and labelled in both Hindi and English.
- 5.2.23 The contractor shall prepare and submit 'Spill prevention and control plans' before the start of construction, clearly stating measures to stop the source of the spill, to contain the spill, to dispose the contaminated material and hazardous wastes, and stating designation of personnel trained to prevent and control spills. Hazardous wastes include pesticides, paints, cleaners, and petroleum products.
- 5.2.24 Contractor shall collect the relevant material certificates for materials with high recycled (*both post-industrial and post-consumer*) content.
- 5.2.25 Contractor shall collect the relevant material certificates for rapidly renewable materials such as bamboo, wool, cotton insulation, agrifiber, linoleum, wheat board, strawboard and cork.
- 5.2.26 The contractor shall ensure that a flush out of all internal spaces is conducted prior to handover. This shall comprise an opening of all doors and windows for 14 days to vent out any toxic fumes due to paints, varnishes, polishes, etc.
- 5.2.27 Contractor shall make efforts to reduce the quantity of indoor air contaminants that are odorous or potentially irritating harmful to the comfort and well-being of installer and building occupants. Contractor shall ensure that the VOC (*Volatile Organic Compounds*) content of paints, coatings and primers used must not exceed the VOC content limits mentioned below:

#### **Paints**

Anti-corrosive/ anti rust - 250 g/L  
 Coatings / Clear wood finishes Varnish - 350 g/L  
 Lacquer - 550 g/L  
 Floor coatings - 100 g/L Stains - 250 g/L Sealers  
 Waterproofing sealer - 250 g/L  
 Sanding sealer - 275 g/L  
 Other sealants - 200 g/L

**The VOC (*Volatile Organic Compounds*) content of adhesives and sealants used must be less than VOC content limits mentioned:**

Architectural Applications VOC Limit (g/l less water)

Indoor Carpet adhesives - 50

Pad Adhesives - 50

Wood Flooring Adhesives - 100

Floor Adhesives - 60

Sub Floor Adhesives - 50

Ceramic Tile Adhesives - 65

VCT and Asphalt Tile adhesive - 50

Dry Wall and Panel Adhesives - 50

Structural Glazing Adhesives - 100

Multipurpose Construction Adhesives - 70

Substrate Specific Application VOC Limit (g/l less water) Metal to Metal - 30

Plastic Foams - 50

Porous material (except wood) - 50 Wood – 30

Fiber Glass – 80

5.2.28 Wherever required, Contractor shall meet and carry out documentation of all activities on site, supplementation of information, and submittals in accordance with GRIHA LD program standards and guidelines. Towards meeting the aforementioned building environmental rating standard(s) expert assistance shall be provided to him up on request.

5.2.29 Contractor shall provide quantities, manufacturer's data, O&M manuals, and Certificates required from manufacturer in accordance with GRIHA LD program requirement for all equipment and materials.

#### **5.2.30 Water Use during Construction**

Contractor should spray curing water on concrete structure and shall not allow free flow of water. After liberal curing on the first day, all the concrete structures should be painted with curing chemical to save water. Areas on which the curing compound is to be used shall be decided by Engineer (*as on some areas water may also be used for curing*) for water curing nothing shall be paid extra. Concrete structures should be kept covered with thick cloth/gunny bags and water should be sprayed on them. Contractor shall do water ponding on all sunken slabs using cement and sand mortar.

5.2.31 The Contractor shall remove from site all rubbish and debris generated by the Works and keep Works clean and tidy throughout the Contract Period. All the serviceable and non-serviceable (*malba*) material shall be segregated and stored separately. The malba obtained during construction shall be collected in well-formed heaps at properly selected places, keeping in a view safe condition for workmen in the area.

Materials which are likely to cause dust nuisance or undue environmental pollution in any other way, shall be removed from the site at the earliest in the plot elsewhere and ***nothing extra shall be paid*** for cartage within the campus and till then they shall be suitable covered. Glass & steel should be dumped or buried separately to prevent injury. The work of removal of debris should be carried out during day. In case of poor visibility artificial light may be provided. Debris shall be disposed in the campus within a lead of 2 kms by digging a



well and properly covering the same with soil. ***Nothing extra shall be paid*** for this.

### 5.3 MATERIALS & FIXTURES FOR THE PROJECT

- 5.3.2 All materials sourced specifically for construction at this project, shall be strictly sourced from a distance (*as specified in GRIHA guidelines*) from the project site. Contractor shall collect the relevant material certificates to prove the same
- 5.3.2.1 Any material that is to be sourced from outside the prescribed radius shall be done after securing the necessary approval from the Engineer/DFCCIL.
- 5.3.2.2 All cement used at site for mortar, plaster, building blocks, etc. shall be PPC (*Portland Pozzolana Cement*) unless otherwise specifically mentioned in the tender documents. The PPC must meet the requirements of IS 1489: 1991.
- 5.3.2.3 As a measure to reduce wastage and water consumption during construction, the contractor shall source or set up the infrastructure for a batch mix concrete.
- 5.3.2.4 The contractor has to comply as per MoEF issued notification 8.0.763(E) dated 14th Sept.1999 containing directive for greater fly ash utilization, where it stipulates.
- 5.3.2.5 The contractor shall ensure that all paints, polishes, adhesives and sealants used both internally and externally, on any surface, shall be Low VOC products. The contractor shall get prior approval from the Architects and the Engineer/DFCCIL before the application of any such material.
- 5.3.2.6 All plumbing and sanitary fixtures installed shall be as per the prescription of the Engineer/DFCCIL and shall adhere to the minimum LPM and LPF mentioned.
- 5.3.2.7 The contractor shall employ 100% zero ODP (*ozone depletion potential*) insulation; HCFC (*hydro-chlorofluorocarbon*)/ and CFC (*chlorofluorocarbon*) free HVAC and refrigeration equipment and/halogen-free fire suppression and fire extinguishing systems.
- 5.3.2.8 The contractor shall ensure that all composite wood products/agro-fibre products used for cabinet work, etc. do not contain any added urea formaldehyde resin.

### 5.4 RESOURCES CONSUMED DURING CONSTRUCTION

- a) The contractor shall ensure that the least amount of water and electricity is wasted during construction. The Engineer/DFCCIL can bring to the attention any such wastage and the contractor will have to ensure that such bad practices are corrected.
- b) The contractor shall install necessary meters and measuring devices to record the consumption of water, electricity and diesel on a monthly basis for the entire tenure of the project.
- c) The contractor shall ensure that all run-off water from the site, during construction is collected and reused to the maximum.
- d) The contractor shall use treated recycled water of appropriate quality standards for construction, if available.
- e) No lights shall be turned on during the period between 6:00 AM to 6:00 PM, without the permission of the Engineer/DFCCIL.

- f) The contractor is encouraged to use bio-diesel in place of petroleum diesel for the running of generators during construction.

## 5.5 CONSTRUCTION WASTE

- a) Contractor shall ensure that wastage of construction material is kept to a maximum of 3%.
- b) All construction debris generated during construction shall be carefully segregated and stored in a demarcated waste yard. Clear, identifiable areas shall be provided for each waste type. Employ measures to segregate the waste on site into inert, chemical, or hazardous wastes.
- c) All construction debris shall be used for road preparation, back filling, etc., as per the instructions of the Architects and the Engineer/DFCCIL, with necessary activities of sorting, crushing, etc. and surplus shall be disposed of in a well after digging a well for this purpose and suitably covered with soil within the 2 kms lead in the plot. ***Nothing extra shall be paid*** for this.
- d) No construction debris shall be taken away from the site, without the prior approval of the Engineer.
- e) The contractor shall recycle the unused chemical/hazardous wastes such as oil, paint, batteries, and asbestos.
- f) If and when construction debris is taken out of the site, after prior permissions from the Engineer then, the contractor shall ensure the safe disposal of all wastes and will only dispose of any such construction waste in approved dumping sites.
- g) Inert waste to be disposed of by Municipal Corporation/ local bodies at landfill sites.
- h) The facility for cleaning the tyres of trucks/ dumpers carting the material shall be provided at the entry points and sedimentation trap shall be made. ***Nothing shall be extra payable*** on this account.

## 5.6 Documentation

- a) The contractor shall, during the entire tenure of the construction phase, submit the following records to the Engineer/DFCCIL on a monthly basis:
  - i) Water consumption in litres
  - ii) Electricity consumption in 'kwh' units
  - iii) Diesel consumption in litres
  - iv) Quantum of waste generated at site and the segregated waste types divided into inert, chemical and hazardous wastes.
  - v) Digital photo documentation to demonstrate compliance of safety guidelines.
- b) The contractor shall, during the entire tenure of the construction phase, submit the following records to the Engineer/DFCCIL on a weekly basis:

- i) Quantities of material brought into the site
- ii) Quantities of construction debris (*if at all*) taken out of the site
- iii) Digital photographs of the works at site, the workers facilities, the waste and other material storage yards, pre-fabrication and block making works, etc. as guided by the Engineer/DFCCIL.
- c) The contractor shall submit one document after construction of the buildings, a brief description along with photographic records to show that other areas have not been disrupted during construction. The document should also include brief explanation and photographic records to show erosion and sedimentation control measures adopted. Document CAD drawing showing site plan details of existing vegetation, existing buildings, existing slopes and site drainage pattern, staging and spill prevention measures, erosion and sedimentation control measures and measures adopted for top soil preservation during construction
- d) The contractor shall submit to the Engineer after construction of the buildings, a detailed as built quantification of the following:
  - i) Total materials used,
  - ii) Total top soil stacked and total reused
  - iii) Total earth excavated,
  - iv) Total waste generated,
  - v) Total waste reused,
  - vi) Total water used,
  - vii) Total electricity, and
  - viii) Total diesel consumed.
- e) The contractor shall submit to the Engineer, as built drawings after construction of the buildings as detailed.
- f) The contractor shall submit to the Engineer/DFCCIL, before the start of construction, a site plan along with a narrative to demarcate areas on site from which top soil has to be gathered, designate area where it will be stored, measures adopted for top soil preservation and indicate areas where it will be reapplied after construction is complete.
- g) The contractor shall submit to the Engineer/DFCCIL, a detailed narrative (*not more than 250 words*) on provision for safe drinking water and sanitation facility for construction workers and site personnel.
- h) Provide supporting document from the manufacturer of the cement specifying the fly- ash content in PPC used in reinforced concrete/ in other works.
- i) Provide supporting document from the manufacturer of the pre-cast building blocks specifying the fly ash content of the blocks used in an infill wall system.
- j) The contractor shall, at the end of construction of the buildings, submit to the Engineer,

submit following information, for all material brought to site for construction purposes, including manufacturer's certifications, verifying information, and test data, where Specifications sections require data relating to environmental issues including but not limited to:

- i) Source of products: Supplier details and location of the supplier.
- ii) Project Recyclability: Submit information to assist Employer/Engineer and Contractor in recycling materials involved in shipping, handling, and delivery, and for temporary materials necessary for installation of products.
- iii) Recycled Content: Submit information regarding product post industrial recycled and post consumer recycled content. Use the "Recycled Content Certification Form", to be provided by the Commissioning Authority appointed for the Project.
- iv) Product Recyclability: Submit information regarding product and product's component's recyclability including potential sources accepting recyclable materials.
- v) Provide certification for all wood products provided by a Forest Stewardship Council (*FSC - or equivalent organization*) accredited certifier.
- vi) Provide final certification of well-managed forest of origin to provide final documentation of certified sustainably harvested status: Acceptable wood "certified sustainably harvested" certifications shall include:
  - a) Wood suppliers' certificate issued by one of the Forest Stewardship Council-accredited certifying agencies;
  - b) Suppliers' invoice detailing the quantities of certified wood products for project;
  - c) Letter from one of a certifying agency corroborating that the products on the wood supplier's invoice originate from certified well-managed forests.
- k) Clean tech: Provide pollution clearance certificates from all manufacturers of materials
- l) Indoor Air quality and Environmental Issues: Submit emission test data, sourced from the manufacturers, produced by acceptable testing laboratory listed in Quality Assurance Article for materials as required in each specific Specification section.
  - a. Certifications from manufacturers of Low VOC paints, adhesives, sealant and polishes used at this particular project site.
  - b. Certification from manufacturers of composite wood products/agro fibre products on the absence of added urea formaldehyde resin in the products supplied to them to this particular site.
  - c. Submit environmental and pollution clearance certificates for all diesel generators installed as part of this project.
- m) Provide total support to the Architects / Engineer / Green Building Consultants appointed by the DFCCIL in completing all Green Building Rating related formalities, including signing of forms, providing signed letters in the contractor's letterhead.

## 5.7 EQUIPMENT

- a) To ensure energy efficiency during and post construction all pumps, motors and engines used during construction or installed, shall be subject to approval and as per the specifications of the architects.
- b) All lighting installed by the contractor around the site and at the labour quarters during construction shall be CFL bulbs of the appropriate illumination levels. This condition is a must, unless specifically prescribed.

The contractor is expected to go through all other conditions of the GRIHA rating stipulations, which can be provided to him by the Architects/Engineer/DFCCIL. Failure to adhere to any of the above mentioned items, without necessary clearances from the Engineer/DFCCIL shall be deemed as a violation of contract and the contractor shall be held liable for ***penalty as determined by the Engineer/DFCCIL.***

## **PART – II**

# **TECHNICAL SPECIFICATIONS**

## **GENERAL TECHNICAL SPECIFICATION**

All CPWD-DSR works shall be executed as per latest CPWD specifications-2019 (as amended up to date) and relevant BIS Codes (amended up to date) and other relevant codes as per directions of Engineer.

Works for which CPWD specifications or other relevant code are not available, execution of work shall be carried out in accordance with Technical specifications as given in the tender document. Further, if any specification(s) is not available in technical specification as provided in the tender document, standard practices and/or Manufacturer's catalogue are to be referred in consultation with Engineer and decision of Engineer is final in this regard.

**TECHNICAL SPECIFICATIONS - GENERAL**  
**(SECTION-1)**



## **TECHNICAL SPECIFICATIONS -GENERAL**

### **1. General: -**

The scope of work covers execution of the Interior, Finishes, Services and Allied works for HHRI Building Complex consisting of Administrative Block, Hostel Block & 2<sup>nd</sup> floor of CTP-14-14 Office in accordance with the BOQ and Technical Specifications provided in the Tender Documents and to the satisfaction of the Architect/Engineer.

Unless provided otherwise the work shall be executed as per CPWD specifications 2019 Volume I & II with up to date amendments, and correction (if any). All relevant Indian Standard (IS) codes related to items of work shall be followed for execution.

### **2. Drawings:**

Drawings shall be furnished to the contractor for his own use and to be kept at site office for reference & execution of works till the completion of the project in all respect. It shall be accessible at all reasonable times to the Architect/Engineer and their representatives. All important drawings are to be mounted on boards and placed in racks and indexed.

### **3. Dimensions:**

Figured dimensions are in all cases to be followed & accepted in preference to scaled sizes. Large-scale details take precedence over small-scale drawings. In case of discrepancy the Contractor is to ask for clarification before proceeding with the work. The decision of Architect/Engineer shall be final and binding.

### **4. Contractor to inspect site:**

The contractor shall visit and examine the construction site and satisfy himself as to the nature of the existing roads or other means of communications, the extent and magnitude of the work and facilities for obtaining materials and shall obtain generally his own information of all matters affecting the execution of the project. Misunderstanding or incorrect information on any of these points or on expenses incurred by the contractor in connection with obtaining site data/information or efforts in compiling the tender shall be borne by the Tenderer/Contractor and no claims for reimbursement thereof shall be entertained.

#### **4.1 Access to Site:**

The Contractor is to include in his rates for cost of making access to the site, with all-temporary gangways, access platforms etc. as required for execution and completion of the works.

#### **4.2 Setting Out:**

The Contractor shall set out the works in accordance with the plans. All grid/centre lines shall be pegged out to the satisfaction of the Architect/Engineer. The Contractor shall be responsible for the correctness of lay out and any inaccuracies to be rectified at his own expense.

The Contractor shall construct and maintain proper pegging at the intersection of all main walls, columns etc; in order that the lines and levels may be accurately checked at all times.

#### **4.6 Gate Keeper and Watchmen:-**

- 4.6.1 The Contractor from the time of being placed in possession of the site must make arrangements for watching, lighting and protecting the work, all materials, workmen and the public during day and night on all days including Sundays and holidays at his own cost.
- 4.6.2 Before starting the work the contractor shall intimate to the Engineer the number and names of works and other personnel together with a copy of each identity card with photograph along with a list of tools, tackles and construction materials for obtaining respective inward gate pass, in triplicate. The contractor shall be permitted similar outward pass on completion of work and on submission of contractor's copy of same inward pass.
- 4.6.3 The contractor shall apply for gate passes for taking out any materials, tools, tackles etc. brought by him inside the DFCCIL premises based on contractor's copy of inward pass and also for his personnel going out of the DFCCIL premises.
- 4.6.4 The contractor shall be responsible for any unauthorized removal of materials, tools, tackles etc. from the DFCCIL premises.
- 4.6.5 DFCCIL gate office norms to be followed.

**5. Storage for Materials:-**

The Contractor shall provide for all necessary sheds of adequate dimension for storage and protection of materials like cement, lime, timber and such other materials including tools and equipment which are likely to deteriorate by the action of sun wind, rain or other natural causes due to exposure in the open. For cement the contractor shall arrange for leak proof godown of sufficient size.

All such sheds shall be cleared away and the whole area left in good order on completion of the contract to the satisfaction of the Engineer.

All materials, which are stored on the site such as bricks, aggregates etc., shall be stacked in such a manner as to facilitate rapid and easy checking of quantities of such materials.

**6 Cost of Transporting:-**

The Contractor shall allow at his cost for all transporting, unloading, stacking and storing of supplier of goods and materials for this work on the site and in the places approved from time to time by the Architect/Engineer. The Contractor shall consider in his price for transport of all materials controlled or otherwise to the site.

**7. W.C. and Sanitary Accommodation and Office Accessories and Accommodations:-**

The Contractor shall provide at his own cost and expense adequate water closet and sanitary accommodation complying in every respect to the rules and regulations in force of Govt. of India, State Govt. and DFCCIL, for his workmen, for the workmen of sub-contractors, and other Contractor's agents connected with this building project and maintain the same in good working order.

He shall arrange to provide a Dumpy level/Theodolite and at all times maintain in good working order at site, to enable the Architect/Engineer to check the lines and levels of the work.

**8. Materials, Workmanship and Samples:-**

Samples of materials to be used with original/coloured catalogue with specification shall be brought by Contractor well in advance and shall be displayed and kept in separate sample room

on site. Samples of all kind of material to be used shall be getting approved from Architect/Engineer.

Materials shall be of approved quality and the best of their kind available and shall generally conform to I.S. Specifications. The Contractor shall order all the materials required for the execution of work as early as necessary and ensure that such materials are on site well ahead of requirement for use in the work. The work involved calls for high standard of workmanship with accelerated progress to the entire satisfaction of the Architect/Engineer.

**8.1 Rate to Include:-**

The Rates quoted shall be for all lead, heights and depths and for finished work complete in all respect and to the satisfaction of Architect/Engineer unless specifically mentioned in this agreement.

**8.2** The Contractor shall plan during execution, the position of chases, pockets, holes dismantling, excavation etc. before the work is taken in hand as no claims for making chases, pockets, holes, dismantling, excavation etc. shall be allowed for already executed work by the contractor in consequence of any neglect or wrong sequence of working by the Contractors.

**9. Foreman and Tradesman:-**

All Tradesmen shall be experienced men properly equipped with suitable tools for carrying out all the work of carpentry and joinery and other specialist trades in a first class manner and where the Architect/Engineer deem necessary, the Contractor shall provide any such tools, special or ordinary, which are considered necessary for carrying out of the work in a proper manner.

All such tradesman shall work under an experienced and properly trained Foreman, who shall be capable of reading and understanding all drawing, pertaining to this work and the Contractor shall also comply with other conditions set out in the General Conditions of the Contract.

**10. Work Programme/Progress Report:-**

The Contractor shall prepare and submit to Engineer for approval, programme of construction of various items, fitted within the period stipulated for completion. The Contractor shall also furnish necessary particulars monthly progress reports in the form furnished by the Engineer. Approved programme shall be the basis for monitoring the progress of work. The contractor shall submit monthly progress report by 10<sup>th</sup> of every month.

**12. Progress Photographs:-**

The Contractor shall at his own expense supply to the Architect/Engineer with photographs of the works taken from two approved portions of each building, in every month during the progress of the work, or at every important stages of construction.

**13. Preparation of Building for occupation and use on Completion:-**

The whole of the work shall be thoroughly inspected by the Contractor and all deficiencies and defects put right. On completion of such inspection, the Contractor shall inform the Engineer and DFCCIL in writing that he has finished the work and it is ready for the inspection.

On completion, the Contractor shall clean all assets created including windows and doors and all glass panes, cleaning of all floors, skirting, dados, staircases and every part of the building including oiling all hardware. He will leave the entire building neat and clean and ready for immediate occupation and to the satisfaction of the Architect/Engineer/DFCCIL.

**14. Contractor to Provide Board:-**

The Contractor shall provide notice on proper supports 3 m x 2 m (10' x 6') in a position approved by the Architect/Engineer showing name of work, name of Architect, Structural Consultants; General Contractor all letters except that of the name of the work shall be in letters to the approval of the Architect/Engineer. He will also display safety notices as per requirement and direction of Architect/Engineer.

**15. Vouchers:-**

The Contractor shall furnish the Architect/Engineer with vouchers on request to prove that the materials are as specified in contract and for non tender items to indicate the rate at which the materials are purchased in order to work out the rate analysis of the non-tender items which he may be called upon to carry out. He will also have to provide the gate entry challan etc.

**16. Protection:-**

The Contractor shall properly cover up and protect all work throughout the duration of work until completion, particularly masonry/finish, moulding, steps, terrazzo or special floor finishes, staircase and balustrades, doors and window frames, plaster angles, lighting and sanitary fittings, glass, paint work and all finishing works. Contractor has to take all necessary precautions & protection arrangement to avoid any damage of floors/walls etc. of employer assets handed over to contractor for use otherwise contractor has to replace damaged assets at his own cost.

**17. Workmanship: -**

- 17.1 The workmanship is to be the best possible and of a high standard. The contractor shall take all steps immediately to make up deficiency if any noticed by the Architect/Engineer. Contractor has to deploy specialised tradesmen (if required) for carrying out work as per specifications for which allowance must be made in the quoted rates.
- 17.2 Contractor shall maintain uniform quality and consistency in workmanship throughout the execution of the work.
- 17.3 The contractor shall be responsible for providing and maintaining temporary coverage required for the protection of finished work. He is also to clean out all wood shavings; cut ends and other waste from all parts of the works before covering of infillings are constructed.
- 18. The Architect/Engineer shall have full powers and authority to issue such instructions as to the order of proceeding with or carrying out the work as he may deem necessary for the guidance of the Contractor and contractor shall be bound by such instructions of the Architect/Engineer.
- 19. The levels and measurements of the existing site, as shown in the drawings, are believed to be correct, but the Contractor should verify them for himself. No claim or allowance whatsoever will be entertained hereafter on account of any errors or omission in the description of the site turning out differently from what was expected or shown in the drawings.
- 21. Any loss or damage caused due to fault or negligence on the part of Contractors labours, staff etc. during working in the premises will be made good by contractor at no extra cost.

**TECHNICAL SPECIFICATIONS FOR INTERIOR FITOUT &  
FURNITURE WORKS - NON SCHEDULED ITEMS  
(SECTION-2)**

## TECHNICAL SPECIFICATIONS FOR NON SCHEDULE ITEMS

### 1.2 WALL LINING/VENEER WORK

- 1.2.1 Stone to be laid shall be wetted before laying. They shall then be fixed with mortar in position without the use of chips or under pinning of any sort. Attempt shall be made to match the grains of veneer work as directed by the Engineer. For purpose of matching the grains, the marble slabs shall be selected judiciously. Preferably the slabs shall be those got out of the same block from the quarry. The design shall be reproduced on the ground and the marble slabs should be laid in position and arranged in the manner to give the desired matching of grains. Any adjustment needed for achieving the best results shall be then carried out by interchanging the particular slabs. Special care shall be taken to achieve the continuity of grains between the two slabs one above the other along the horizontal joints. Each marble slabs numbered properly and the same number shall be marked on a separate drawing as well as on the surface to be actually veneered, so as to ensure the fixing of the particular slabs in the correct location.
- 1.2.2 Where cramps are used to hold the unit in position only, the facings shall be provided with a continuous support on which the stones rest at the ground level and other storey levels, the support being in the form of projection from or recess into the concrete floor slab, or a beam between the columns or a metal angle attached to the floor slab or beams. These supports shall preferably be at vertical intervals not more than 3.5 m apart and also over the heads of all openings. Such supports shall also be provided where there is transition from thin facing below to thick facings above.
- 1.2.3 Measurements the length and breadth shall be measured correct to a cm. In case of radially dressed or circular slabs used in the work, the dimensions of the circumscribing rectangles of the dressed stone used in the work, shall be measured & paid for. The area shall be calculated in sqm nearest to two places of decimal.
- Marble work in lining upto 4 cm thickness shall be paid by area under veneer work and lining of greater thickness paid by volume under plain marble work.
- 1.2.4 Pointing all exposed joints shall be pointed with mortar as specified. The pointing when finished shall be sunk from stone face by 5 mm or as specified. The depth of mortar in pointing work shall not be less than 15mm.
- 1.2.5 Measurements the length and breadth of the finished work shall be measured in metre correct to cm. The area should be calculated in sq. metre correct to two places of decimal.

The veneering work curved on plan shall be measured as plain work, but extra payment shall be allowed for radii for individual stone not exceeding six metres on external face. For radius beyond six metres the work shall be measured as plain work only.

### 1.3 LACQUERED GLASS:

**6 mm:** 6 mm shall be Extra Clear Glass used for lacquered glass.

Lacquered glass to be made industrially (via air brushing process); opaque (if viewed against a support wall), coated with WATER BASED lacquer colour of brand Colour Spray AQUA by Regalead – United Kingdom Or Equivalent Brand ;Which is binded by nano particle pure acrylic); Gloss Level – 40 ; where VOC < 1% ; highly durable ; humidity resistant (conforms to BS EN 1036 1999); environmentally friendly (no lead, no arsenic, no copper, no formaldehyde; compressive strength (1000 MPa) & tensile strength (40 MPa), same as float glass as per the detailed drawings and as approved by Architect/DFCCIL. Colour to be checked and tested via INDEX Colour shade card used worldwide as a colour choosing parameter.

#### INSTALLATION:

Before fitting the glass as a wall covering/paneling requires checking the state of the walls to avoid any deterioration in the paint on the back of the glass • should be fixed on a plain, dry, and clean surface free of aggressive agents • the entire surface should be in a uniform colour or ply colour to ensure a uniform appearance after installation • Glass should not be fixed on the support directly; there should be some space between the and the support to ensure air circulation • Air circulation space should be gap of 1–2 mm between the edges of two glass panels • In case a frame is being used for fixing ensure that the frame is dry and clean • Layout for installation should be prepared prior to installation of the glass • A neutral base Clear silicone, Pentagon mounting tape, and ensure that the tape is pasted in a vertical direction Acid-based silicone should not be used to fix • In case glass is being fixed on plywood, ensure that the surface of the plywood is free from any chemical, lubricant, or moisture • it is recommended tht installation on perfectly levelled 12 mm-thick water-proof marine plywood/BWP/ MDF / Mineral fibreboard which is mounted on RCC wall / any other structure • If double-sided adhesive tape is used, mounting tape, and ensure that the tape is pasted in a vertical direction.

#### HANDLING AND CUTTING

Always use clean gloves when handling lacquered glass • Lift the sheets one by one • When handling sheets with suction cups, apply cups to the flat, untreated surface. If this is not possible, extra care should be taken to ensure that proper vacuum is achieved. Be sure to keep the cups clean and free of dust • Regularly sweep the cutting tables with a stiff brush to control dust and to minimize any glass grit and particles which could scratch the glass • Individual sheets should be washed after cutting to reduce the chance of staining from cutting oil • Glass sheets are cut most easily by scoring the flat,

untreated side. If not possible, increased cutting pressure may be required, and testing is recommended prior to cutting stock sheets • Never allow coolant or cerium oxide to dry on the glass, as it may become a permanent stain on a porous surface • Painted side of the lacquered glass should be placed on the table while cutting • Care must be taken to insert paper or cardboard spacers in order to avoid scratches.

## **1.4 FULLY AUTOMATIC GLAZED SLIDING DOOR: -**

### **1.4.1 General:-**

Automatic sliding door operator Automatic sliding door Set 1 operator as per approved dwg. Compliant with European standards. Product should be TÜV test certified for 1 Million cycles, tested according to the low voltage guidelines & operator unit power consumption not exceeding 100 W/Hr, fulfils DIN 18650 standards. The track profile should be flexible for both surface mounted & ceiling hung application with additional profile for vibration & sound dampening feature. It should include micro processor controlled drive unit, with self learning mechanism, program selector with knob, motion detection sensor – 2 nos, 1 on each side, including passage safety combi-sensor on one side, mechanical components, toothed belt, cover profile not exceeding 110mm visible H, floor guide for frameless glass (02 nos), glass clamping rail (02 nos), Body finish : standard silver anodised operator profile electromechanical lock with 12 mm plain toughened frameless glass for complete elevation - 2 moving panels. UPS of 750 VA shall be provided by others, which will give power backup of 20 min. Only & if the duration of power cut to the operator is more than 30 min., then separate arrangement needs to be done for the same as automatic operator requires uninterrupted stabilized power supply. It should include wall corner Protection. (WCP)

All complete as per direction of Engineer.

### **1.4.2 Installation:-**

The track profile should be separate from the main profile for enabling reduction in vibration insulation. Microprocessor control, self-learning, reverses when obstruction is encountered. Microprocessor-controlled control unit. It should be Self-learning, with adjustable parameters for opening and closing speed, hold-open time and opening and closing force. Class of protection IP 20. The electric operating Mechanism shall be mounted and concealed within the Stainless Steel header and the Controller Unit shall be Micro Processor Based.

### **1.4.3 Technical Parameters: -**

Parameter	
Drive Unit	Top mounted actuator
Travel Control	Encoder



system	
Capacity	90 kg each leaf maximum
Power Supply	< 100 W
Duty Class	5-very heavy duty
Intermittent operation	S3=100%
Opening speed	150-600 mm/s (Adjustable)
Closing Speed	100-550 mm/s (Adjustable)
Opening Time	0-9 Seconds (Adjustable)
Accessories Power supply	24V=0.5A
Manually adjustable functions	Drive force. Dwell time during opening 0-30 seconds. Partial opening.
Self-adjusting functions	Maximum opening closing limits Rotary programmer.
Safety devices	Combi Sensor(Microwave+ Infrared)/Built-in photocells
Control Switch	Pair of microwave radar for open & close operations
Std. Cable Length	5 Mtr - Motor to Radar & 5 Mtr - Motor to Sensor
Safety devices	Combi Sensors for passage safety/Built-in photocells
Test Certificate	1 million Cycle

**Features:-**

1. CE marked according to the European Machinery Directive 2006/42/CE and type tested according to standard European Norm 13241-1.
2. Extruded anodized aluminum profile sliding guide and casing, sliding on reinforce nylon wheels.
3. Electronic control board with microprocessor.

4. Built in electronic antic rush devise with encoder.
5. Manual and automatic settings with trimmer and dipswitch.
6. Automatic closing, reversal safety, obstacle detection, adjustment, automatic closer time.
7. Test certification for the number of cycle tested.

#### **1.4.4 HARDWARE:**

##### **1.4.4.1 Hydraulic Door Closer: -**

Overhead cam action door closer with adjustable closing force EN2-4.

##### **1.4.4.2 Floor Spring: -**Double action floor spring for door including cost of cutting floor required, embedding in floor and cover plates with pivot and single piece sheet cover box with side plates etc. as per direction of Engineer.

Floor spring certified with std. spindle and cover plate. The floor spring with back check and adjustable closing speed. Non-hold open options As per EN 1154 and CE marked. Finish: satin stainless steel.

##### **1.4.4.3 Pull Handle: -**

SS Pull handle of 300 x 25mm size, CTC 212 mm with necessary fixing accessories, washers & screws etc. complete as per direction of Architect/Engineer/DFCCIL. A.150 Back to back with adjustable fixing for glass, wood and metal doors in satin stainless steel. The pull handles should have supporting washer with raised beveling on the outer surface. Length=171mm, 19mm dia, ctc 152mm- SS304. 300 back to back with adjustable fixing for glass, wood and metal door in satin stainless steel. The pull handles should have. Supporting washer with raised beveling on the outer surface. Length=300MM, 25MMDIA-SS304 supporting washer with raised beveling on the outer surface. Length=300MM, 25MMDIA-SS304

##### **1.4.4.4 Lever Handle with Lock: -**

Tubular lever handle with sash lock with back set, Foreend, Euro profile cylinder with one side key and other side knob operation with strike plate and fitting with necessary screws etc. complete

- a. External trim lever type finish: silver. Complete set including spindle, screws & all fixing accessories.
- b. pin euro profile half cylinder with one side key operation standard length 42mm in satin nickel plated finish with 3 keys. Optional master keying and grand master keying can be done on request.
- c. Lever handle package consist of tubular lever handle sash lock with 55mm back set, CTC-72mm and 20 mm for end, euro profile cylinder with one side key and other side knob operation with 20 SS strike plate.

## **1.5 PATCH DOOR**

12 mm thick frameless toughened glass door shutter of approved brand and manufacture, including providing and fixing top & bottom pivot & spring type fixing arrangement and making necessary holes etc. for fixing required door fittings, all complete as per direction of Architect/Engineer/DFCCIL.

### **Hydraulic Floor Spring**

The hydraulic floor spring shall be heavy duty double action floor spring of make approved by the Architect/Engineer/DFCCIL suitable for door leaf of weight minimum 100 kg. The top cover plate shall be of stainless steel, flushing with floor finish level. The contractor shall cut the floor properly with stone cutting machine to exact size & shape. The spindle of suitable length to accommodate the floor finish shall be used.

### **Measurements**

All the door sections including snap beadings fixed in place shall be measured in running meter along the outer periphery of composite section correct to a millimetre. The weight of cleat shall be added for payment. Neither any deduction nor anything extra shall be paid for skew cuts.

## **1.6 False Ceiling:**

### **Baffle Ceiling**

Providing & fixing Vertical Linear Baffle Ceiling made out of Aluminum Extrusion in Aluminum alloy grade 6063. The baffle blade shall be in size of 100x25x3600mm in powder coated Black finish. The baffle blade shall be suspended using Slotted U-profile at on-center spacing in multiples of 25mm. Longer lengths of Baffle to be connected by Baffle Joiner and the ends to be fixed with End caps.

### **Installation of U-Grid:**

The U profile to be suspended at every 1200mm on-centre using 6mm threaded rod from the structural soffit using U-profile hanger. U-profile splice to be used to join more than one U profiles of length 3.75M. 1st U-Grid Channel must be no more than 400mm from the perimeter

### **Installation of Baffles:**

Locate the slot for Baffle Hangers in U Profile section at 1200mm centres. Hangers are inserted into the slot, then rotated 90° and fixed into position by tightening the grub screw. Baffle to be lifted into position and hangers engage over lip of U-Grid Channel. Each Hanger to be secured into position by inserting the Locking Clip.

When doing continuous installation, Baffles blades are to be connected at ends with Baffle Joiner, which are inserted into the top and bottom slots of the Baffle closed profile for alignment only. The bottom Joiner to be located first and fastened on one side only. The top Joiner to be fitted then and secured with grub screws on one side. Then the two Baffle sections shall be joined and the top Joiner is screw fastened on the 2nd Baffle profile.

End Caps to be located by pushing the End Cap tongues into open Baffle slots.

Installation to be carried out by Trained Installation team & Installation should be carried out as per recommended procedure.

## **1.7 GI TRAP DOORS**

GI Trap Doors are to be made to big sizes – upto 8' long. For instance, even 8' x 4'. Big frames & shutter are reinforced with stiffeners to prevent warping

Only a uniform 2.5mm groove all around to be provided with sliding hinges, making it blend seamlessly with the ceiling

Trap Door to consist of an Inner Frame and an Outer Frame. Both the frames are to be completely flexible for any size requirement. Material for the frame is Galvanised Iron and the finish can be anodized or powder coated as per the recommendation of Architect/Engineer/DFCCIL.

**Note: Other Non-Scheduled items of Interior Fitout and Furniture works shall be governed with specifications provided in the relevant BOQ Items in the relevant Schedules (Form-4). However, in case of any dispute, the decision of Engineer shall be final and binding.**

**TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS**  
**(SECTION – 3)**

## INTERNAL WIRING

### 1. GENERAL

This section covers specification for Internal wiring of the office area and building.

### 2. STANDARDS AND CODES

The wiring work shall be carried out as per standards and specifications of the CPWD. In addition the relevant clauses of the Indian Electricity Act 2003 and Indian Electricity Rules 1956 as amended upto date shall also apply.

IS:732 - 1989	Code of practice for electrical wiring installations
IS: 8828 - 1978	Miniature air break circuit breakers for voltages not exceeding 1000 volt
IS:13032 - 1991	Miniature circuit breaker boards for voltages upto and including 1000 volts AC
IS:12640 - 1988	Residua current operated circuit breakers
IS:694 - 1990	PVC Insulated cables for working voltages upto and including 1100 V
IS:694 - 1990	PVC Insulated cables for working voltages upto and including 1100 V
IS:9537(Part-1)-1980	Conduits for electrical installations :General requirements
IS:3480 - 1966	Flexible steel conduits for electrical wiring
IS:2667 - 1988	Fittings for rigid steel conduits for electrical wiring
IS: 371 - 1979	Ceiling roses
IS: 3854 - 1988	Switches for domestic and similar purposes
IS: 4615 - 1968	Switch socket outlets (non-interlockingtype)

### 3.1 Introduction

The electric power shall be received and distributed in a building, through following means:-

- (i) Cabling and switchgear to receive power.

The building shall be divided into convenient number of parts, each part served by a rising main system to distribute power vertically/horizontally.

- (ii) Power flows from rising main through tap-off box to floor main board to final DBs and then to wiring.
- (iii) Dedicated circuit for different loads such as lighting, HVAC, power plug loads shall be

provided, wherever possible.

### **3.2 System of Distribution and Wiring**

- (i) The wiring shall be done from a distribution system through main and/or branch distribution boards.
- (ii) Each main distribution board and branch distribution board shall be controlled by an incoming circuit breaker. Each outgoing circuit shall be controlled by a circuit breaker.
- (iii) Only MCCB/MCB DBs shall be used.
- (iv) 'Power' wiring shall be kept separate and distinct from light wiring, from the level of circuits, i.e., beyond the branch distribution boards. Conduits for light/power wiring shall be separate.
- (v) Essential/non-essential/UPS distribution each will have a completely independent and separate distribution system starting from the main, switchboard upto final wiring for each system. No mixing of wiring is allowed.
- (vi) Each MDB/DB/Switch Board will have reasonable spare outgoing ways for future expansion.
- (vii) Balancing of 3-phase circuit shall be done.

### **3.3 Wiring**

#### **3.3.1 Submain & Circuit Wiring**

- (a) Submain Wiring

Submain wiring shall mean the wiring from one main/distribution switchboard to another.

- (b) Circuit Wiring

Circuit wiring shall mean the wiring from the distribution board to the 1st tapping point inside the switch box, from where point wiring starts.

### **3.4 Point Wiring**

#### **3.4.1 Definition**

A point (other than socket outlet point) shall include all work necessary in complete wiring to the following outlets from the controlling switch or MCB.

- (a) Ceiling rose or connector (in the case of points for ceiling/exhaust fan points, prewired light fittings, and call bells).
- (b) Ceiling rose (in case of pendants except stiff pendants).

#### **3.4.2 Scope**

Following shall be deemed to be included in point wiring:

- (a) Wiring cables between the switch box and the point outlet, loop protective earthing of each fan/ light fixture.

- (b) All fixing accessories such as clips, screws, Phil plug, rawl plug etc. as required.
- (c) Control switch or MCB, as specified.
- (d) 3 pin or 6 pin socket, ceiling rose or connector as required. (2 pin and 5 pin socket outlet shall not be permitted.)
- (e) Connections to ceiling rose, connector, socket outlet, lamp holder, switch etc. Bushed conduit or porcelain tubing where wiring cables pass through wall etc.
- (f) Interconnecting wiring between switches within the switch box on the same circuit.

### 3.4.3 Point Wiring for Socket Outlet Points

- (i) The light plug (6 A) point and power (16 A) point wiring shall be measured on linear basis, from the respective tapping point of live cable, namely, switch box, another socket outlet point, or the sub-distribution board as the case may be, up to the socket outlet.
- (ii) The metal/PVC box with cover, switch/MCB, socket outlet and other accessories shall be measured and paid as a separate item.
- (iii) The power point outlet may be 16 A/6 A six pin socket outlet, where so specified in the tender documents.

### 3.4.4 Group Control Point Wiring

- (i) In the case of points with more than one point controlled by the same switch, such points shall be measured in parts i.e. (a) from the switch to the first point outlet as one point and classified accordingly and (b) for the subsequent points, the distance from that outlet to the next one and so on, shall be treated as separate point(s) and classified accordingly.
- (ii) No recovery shall be made for non-provision of more than one switch in such cases.

### 3.4.5 Twin Control Light Point Wiring

- (i) A light point controlled by two numbers of two way switches shall be measured as two points from the fitting to the switches on either side and classified according to 3.4.4.
- (ii) No recovery shall be made for non-provision of more than one ceiling rose or connector in such cases.

## 3.5 Wiring System

- (i) Wiring shall be done only by the looping system. Phase/live conductors shall be looped at the switch box. For point wiring, neutral wire/earth wire looping for the 1st point shall be done in the switch box; and neutral/earth looping of subsequent points will be made from point outlets.
- (ii) In wiring, no joints in wiring will be permitted any where, except in switch box or point outlets, where jointing of wires will be allowed with use of suitable connector.
- (iii) The wiring throughout the installation shall be such that there is no break in the neutral wire except in the form of linked switchgear.
- (iv) Light, fans and call bells shall be wired in the 'lighting' circuits. 15A/16A socket outlets and other power outlets shall be wired in the 'power' circuits. 5A/6A socket outlets shall also be wired in the 'power' circuit both in residential as well as non-residential buildings.



(v) Colour Coding

Following colour coding shall be followed in wiring:

Phase	:	Red/Yellow/Blue.(Three phase
wiring) Live	:	Red (Single phase wiring)
Neutral	:	Black
Earth	:	Yellow/Green.

(vi) Termination of Circuit into Switchboard

Circuit will consist of phase/neutral/earth wire. Circuit will terminate in a switch board (first tapping point, where from point wiring starts) in following manner:

Phase wire terminated in phase connector. Neutral wire terminated in neutral connector. Earth wire terminated in earth connector.

The switchboard will have phase, neutral and earth terminal connector blocks to receive phase/ neutral/ earth wire.

### 3.6 Passing through Walls or Floors

- (i) When wiring cables are to pass through a wall, these shall be taken through a protection (steel/ PVC) pipe or porcelain tube of suitable size such that they pass through in a straight line without twist or cross in them on either porcelain, PVC or other approved material.
- (ii) All floor openings for carrying any wiring shall be suitably sealed after installation.

### 3.7 Joints in Wiring

- (i) No bare conductor in phase and/or neutral or twisted joints in phase, neutral, and/ or protective conductors in wiring shall be permitted.
- (ii) There shall be no joints in the through-runs of cables. If the length of final circuit or submain is more than the length of a standard coil, thus necessitating a through joint, such joints shall be made by means of approved mechanical connectors in suitable junction boxes.
- (iii) Termination of multistrand
- (iv) ded conductors shall be done using suitable crimping type thimbles.

### 3.8 Capacity of Circuits

- (i) Lighting circuit shall feed light/fan/ call bell points. Each circuit shall not have more than 800 Watt connected load or more than 10 points whichever is less. However, in case of LED points where load per point may be less, number of points may be suitably increased.
- (ii) Power circuit in non-residential building will have only one outlet per circuit.
- (iii) Load more than 1 KW shall be controlled by suitably rated MCB and cable size shall be decided as per calculations.

- (iv) Power Wiring with Bus Trunking

### 3.9 Socket Outlets

- (i) Socket outlets modular type shall be 6A 3 pin, 16 Amp 3 pin or 16/6 Amp 6 pin. 5 pin socket outlets will not be permitted.

The third pin shall be connected to earth through protective (loop earthing) conductor. 2 pin or 5 pin sockets shall not be permitted to be used.

- (ii) Conductors connecting electrical appliances with socket outlets shall be of flexible type with an earthing conductor for connection to the earth terminal of plug and the metallic body of the electrical appliance.
- (iii) Sockets for the power outlets of rating above 1KW shall be of industrial type with associated plug top and controlling MCB.
- (iv) Shutter type (interlocking type) of sockets shall be used.
- (v) Every socket outlet shall be controlled by a switch or MCB, as specified. The control switch/MCB shall be connected on the 'live' side of the line.
- (vi) Unless and otherwise specified, the control switches for the 6A and 16A socket outlets shall be kept along with the socket outlets.

### 3.10 Cables

- (i) Copper conductor cable only will be used for submain/ circuit/ point wiring.
- (ii) Minimum size of wiring:
  - Light Wiring : 1.5 sq.mm.
  - Power Wiring : 4.0 sq.mm.
  - Power circuit rated : More than 1 KW, Size as per calculation.
- (iii) Insulation : Copper conductor cable shall be FRLS,PVC insulated Conforming to BIS Specification.
- (iv) Multi stranded : Cables are permitted to be used.

### 3.11 Wiring Accessories

- (a) Switch Box
  - (i) Switch box shall be hot dip galvanized, factory fabricated, suitable in size for surface/ recess mounting and suitable in size for accommodating the required number of switches and accessories (where required to be used for applications other than modular switches/ sockets).
  - (ii) Switch box also can be of non-metallic material. The Engineer will approve specified makes of reputed quality and specifications.
- (b) Ceiling Rose

- (i) A ceiling rose shall not be used on a circuit, the voltage of which normally exceeds 250V.
  - (ii) Only one flexible cord shall be connected to a ceiling rose. Specially designed ceiling roses shall be used for multiple pendants.
- (c) Fittings

Types : The type of fittings shall be as specified in tender documents.

### **3.12 Attachment of Fittings and Accessories**

(a) Conduit Wiring System

- (i) All accessories like switches, socket outlets, call bell pushes and regulators shall be fixed in flush pattern inside the switch/regulator boxes. Accessories like ceiling roses, brackets, batten holders etc. shall be fixed on outlet boxes. The fan regulators may also be fixed on outlet boxes, if so directed by the Engineer-in-charge.
- (ii) Aluminium alloy or cadmium plated iron screws shall be used to fix the accessories to their bases.
- (iii) The switch box/regulator box shall normally be mounted with their bottom 1.25 m from floor level, unless otherwise directed by the Engineer-in-charge.

(b) Fixing to Walls and Ceiling

- (i) Wooden plugs for fixing to wall/ceiling will not be allowed. Fixing will be done with the help of PVC sleeves/Rowel plugs/ dash fasteners as required.
- (ii) Drilling of holes shall be done by drilling machines only. No manual drilling of hole will be allowed.

### **3.13 Fans, Regulators and Clamps**

(a) Ceiling Fans

- (i) Ceiling fans including their suspension shall conform to relevant Indian Standards.
- (ii) The capacity of a ceiling fan to meet the requirement of a room with the longer dimension D meters should be about  $55 D \text{ m}^3/\text{min}$ .
- (iii) The height of fan blades above the floor should be  $(3H + W)/4$ , where H is the height of the room, and W is the height of the work plane.
- (iv) The minimum distance between fan blades and the ceiling should be about 0.3 meters.
- (v) When actual ventilated zone does not cover the entire room area, then optimum size of ceiling fan should be chosen based on the actual usable area of the room, rather than the total floor area of the room.
- (vi) Energy Efficient fans with BEE 3-5 star rating or complying with IS 374: 1979, shall be used. The minimum service value of fans shall be  $3.5 \text{ m}^3/\text{min}/\text{W}$  and air delivery  $200 \text{ m}^3/\text{min}$ .
- (vii) Standard power with air delivery of Fans shall be as per IS 374.
- (viii) All ceiling fans shall be wired to ceiling roses or to special connector boxes, and

suspended from hooks or shackles, with insulators between hooks and suspension rods. There shall be no joint in the suspension rod.

- (ix) The leading in wire shall be of nominal cross sectional area not less than 1.5 sq. mm. and shall be protected from abrasion.
- (x) Unless otherwise specified, all ceiling fans shall be hung 2.75 m above the floor.
- (xi) In the case of measurement of extra down rod for ceiling fan including wiring, the same shall be measured in units of 10 cm. Any length less than 5 cm shall be ignored.

**(b) Exhaust Fans**

- (i) Exhaust fans shall conform to relevant Indian Standards.
- (ii) Exhaust fans shall be erected at the places indicated drawings. For fixing an exhaust fan, a circular opening shall be provided in the wall to suit the size of the frame, which shall be fixed by means of rag bolts embedded in the wall. The hole shall be neatly plastered to the original finish of the wall. The exhaust fan shall be connected to the exhaust fan point, which shall be wired as near to the opening as possible, by means of a flexible cord, care being taken to see that the blades rotate in the proper direction.
- (iii) Exhaust fans for installation in corrosive atmosphere, shall be painted with special PVC paint or chlorinated rubber paint.
- (iv) Installa
- (v) tion of exhaust fans in kitchens, dark rooms and such other special locations need careful consideration; any special provisions needed shall be specified.

### **3.14 Marking of Switch Boards**

**(i) Schematic Diagram**

First a comprehensive schematic diagram for each building is to be prepared, starting from Main LT Panel, rising main, submain boards, DBs, etc. and the manner in which they are connected. This will include essential, non-essential and UPS systems. Sizes of interconnecting main/submain cables shall be indicated.

**(ii) Marking of each Main Board**

Each main board/submain board shall be marked indicating rating of each incoming/outgoing switch and the details of load/area it feeds. Detail/size of incoming and outgoing cable also shall be marked indicating from where the incoming cable has originated.

**(iii) Marking of Distribution Board**

Each Distribution Board shall be marked indicating detail of incoming switch (Size of cable and from where it is fed) and marking of each outgoing MCB indicating the area it feeds. Suitable marking sticker will be suitably fixed to indicate such details.

**(iv) Marking of Power/Light DBs**

Power/light DBs shall be marked 'P' and 'L' respectively.

(v) Marking for Non-essential/Essential/UPS/Switch Boards

Each switchboard shall be marked essential/non-essential/UPS to indicate the nature of such switchboards.

(vi) Marking of Main Earthing Terminal

Main earthing terminals in main/submain switchboard shall be permanently marked, as “Safety Earth – Don’t Remove”.

### 3.15 LT Distribution Switchgear

Only following type switchboards will be used:

- (a) Main/Submain switchboard of cubicle type.
- (b) DBs – Conventional DBs of reputed makes can also be used with the approval of Engineer-in-Charge in addition to prewired DB.
- (c) Specially designed switchboards.

Also specially designed switchboards can be used with detailed specification and fabrication drawings approved by the Engineer-in-Charge.

### 3.16 Location of Switchboards

- (i) Switchboards are to be located in common areas like corridors, lobby etc. and not to be located in locked room.
- (ii) Switchboard shall be located only in dry situation and in well-ventilated space. They shall not be placed in the vicinity of storage battery or exposed to chemical fume.
- (iii) Switchboards shall not be erected above gas stove, or sinks or within 2.5 meter of any washing unit in washing rooms of laundrerings or in the bath rooms, toilets, or kitchen.
- (iv) As far as possible main boards shall not be located in basement. Such main boards can be located in ground floor.
- (v) It is preferable to locate floor main boards in rising main shafts of adequate size, with steel doors (having ventilation) or in suitable room.
- (vi) Similarly DBs can be in suitable niches in corridor walls having doors.
- (vii) Locating main boards under staircase or standing open in corridor is not a desirable practice, besides being highly unaesthetic.
- (viii) The main switchboard, which receives power to the building, should be invariably located in a switch room, having round the clock access, for emergency attendance to the switchboard.

## 4. LIGHTING SYSTEM

### 4.1 SCOPE

- a. The Contractor shall design, supply, install, test and commission a high efficiency lighting system for all areas of the buildings. Light fittings for all areas shall be complete with lamps, supports and accessories. The light fittings and all associated accessories shall be subject to the acceptance of the Engineer.
- b. Lux level study shall be conducted to assess the lux levels in various areas as per NBC and then luminaire type and quantity drawing to be submitted accordingly for approval of the Engineer-in-Charge.
- c. The quantity of the luminaires is only indicative as per attached drawings which may change according to the lux level report submitted.
- d. Lighting levels shall be uniformly distributed throughout the area, and shall be designed such that glare, dark recesses and areas of poor lighting levels are avoided.
- e. The type of luminaries and normal average maintained illumination levels for various areas and services shall be as per prevalent specification of NBC or other applicable codes.
- f. Various types of luminaires are being employed as per BOQ. The details of application of such variety of lights shall be made available at the time of finalisation of lighting drawing.

## 4.2 ACCEPTABLE CODES AND STANDARDS

The luminaries and associated equipment shall comply with the following codes and standard:

IS: 1913	General Safety Requirements for Luminaires
IS: 1777	Industrial Luminaires with Metal Reflectors
IS: 3553	Specification for Watertight Electric Lighting Fitting
IS: 3528-1966	Water Proof Electric Light Fitting
IS: 1646: 1997	Code of Practice for Fire Safety of Building
IEC 60598-2-1	Fixed General Purpose Luminaires
IEC 60598-1	General Requirements and Tests
IS: 3646 (All 3 Parts)	Code of Practice for Interior Illumination
NFPA	National Fire Protection Association
IEC 62031	LED modules for general lighting-Safety requirements
EN 61547	Equipment for general lighting purposes EMC immunity requirement.
IEC 60598-2-1	Fixed general purpose luminaires
IEC 60598-1	Luminaires- General requirement and tests
IEC 61000-3-2	Electro Magnetic compatibility (EMC) -Limits for Harmonic current emission
IEC 61347-2-13	Lamp control gear : particular requirements for DC or AC supplied electronic control gear for LED modules
IS 10322	Specification for the luminaries
IEC 62384	DC or AC supplied electronic control gear for LED modules performance requirements
EN 13032-1	Measurement and presentation of photometric data of lamps and luminaires: Measurement and file format
EN 13032-2	Measurement and presentation of photometric data of lamps and luminaires: Presentation of data for indoor and outdoor work places
LM 79	Internationally recognized method for the electrical and photometric measurement of solid state lighting products
LM 80	Internationally recognized method for measuring lumen maintenance of LED light sources

IEC 60529  
IS 16108.2012

Classification of degree of protections provided by enclosures  
Photo biological safety of Lamps & Lamp Systems

### 4.3 SYSTEM DESCRIPTION

The lighting system shall comprise of the following:

#### I. Normal Lighting

The normal lighting shall be fed from normal supply Distribution Boards.

#### II. Emergency Lighting

10% of lighting fixtures in all areas and minimum one light in each chamber shall be emergency light fixtures powered by UPS.

### 4.4 LUMINAIRE

#### 4.4.1 Lighting Features

Following features are required in the lighting fixtures:

- a. Energy efficient
- b. Long Life
- c. Rugged and durable
- d. Smaller lighting fixture
- e. Environmental friendly – no Mercury
- f. Available in different colours
- g. Better heat management
- h. Use of good quality diffuser

#### 4.4.2 Design Parameters

Following parameters shall be met in the Luminaire:

- a. CRI of the source, must be >80
- b. Usable lumen per watt of fitting, must be >100 lm/W
- c. Glaring Index of fixture, UGR<19
- d. Life of lamp, must be 50k+

#### 4.4.3 Construction

The luminaire shall be made of extruded or die cast aluminium, otherwise as specified in the BOQ.

#### 4.4.4 LED Chip

Suitable number of LED lamps shall be used in the luminaires. LED lamps of NICHIA/CREE/OSRAM/ SEOUL/BRIDGELUX/ make shall be used for the purpose.

High power and high lumen efficient LEDs shall be used: The efficiency of the LED lamps at 85 Deg C junction temperature shall be more than 100%.

The working life of the lamp at junction temperature of 85 Deg C at rated current shall be more than 50,000 working hours @ L70 of accumulative operation.

These features shall be supported with data-sheet. Colour temperature of the proposed white colour LED shall be as mention in BOQ and the color variation should be within MacAdam Step specified in the fixture description in BOQ. The output of LED shall be more than 100 lumen per watt at minimal operating current and shall ensure guaranteed Lumen maintenance report as per guidelines shall be produced for the power LEDs used. Power factor of complete fitting shall be more than 0.9 at full load

All manufacturers must confirm that all supplied LEDs fall within a 3-step MacAdam

#### 4.4.5 Secondary Optic:

Suitable diffuser (made of PC/PMMA) or lenses shall be provided to increase the illumination uniformity and distribution.

#### 4.4.6 Parameters

Each luminaire shall meet the following parameters, or as specified in the BOQ:

- Fixture should have minimum efficacy at System level (Not Chip Level)  $\geq 110$  lumens/watt, unless otherwise specified in BOQ
- CRI  $> 80$ ,
- THD  $< 10\%$ ,
- PF  $> 0.90$ ,
- R9  $> 20$ ,
- IP20,
- UGR  $< 19$ ,
- IK  $\geq 04$ ,
- CCT of 5700/6500K (SDCM  $< 3$ )
- Operating working temp range -  $0^{\circ}\text{C} < T_a < 45^{\circ}\text{C}$
- Operating Voltage Range of 140 - 270V.
- Internal Surge Protection 2.5KV
- Flicker free operations ripple  $< 5\%$ ,
- The internal wiring to be done with LSZH wires.
- The fixture should comply with the parameters as per IS10322.
- The LED driver should comply to IEC61000-3-2 ed.3.2, 2009 for Harmonics, IEC61347 -2 -13, 2006 in Conjunction with IEC61347-1 ed.2.0, 2007 for Electrical Safety, IEC62384 ed.1.1, 2011 for performance and IEC61547 ed.2.0, 2009, CISPR-15 for EMI.
- Manufacturer shall have inhouse lab approved by NABL or Ministry of Science, Govt of India or reports to be verified at NABL approved labs for parameters by firm.
- LM79 and LM80 reports need to be submitted from a NABL/UL accredited lab to verify above parameters.
- Both the fixture and Driver should have BIS approval.

#### 4.6 TESTS

The electronics covered for this equipment shall pass all the tests called for in the specification. The tenderer shall indicate the deviation or compliance otherwise the offer may be rejected.

Tests are classified as:

- Type test,
- Routine and

##### Type Test:



Type tests shall be carried out to prove confirmation with the requirement of specification and general quality/design features of the unit. In case of any change in design of unit, complete type test shall be repeated.

#### **Routine Tests:**

These tests shall be performed by the manufacturer on sample(s) taken from a lot as per sampling plan specified by BIS at NABL accredited labs in the presence of Client Representative. The charges for the above tests to be borne by the manufacturer/supplier. The test results shall be submitted to the Engineer. The firm shall maintain the records with traceability.

#### **4.6.1 Test Scheme:**

##### **Routine Test**

1. Visual and Dimensional check
2. Checking of documents of purchase of LED
3. Resistance to humidity
4. Insulation resistance test
5. HV test
6. Over voltage protection
7. Surge protection
8. Reverse polarities
9. Temperature rise Test
10. Ra % (Color Rendering Index) as per BOQ specifications
11. Lux measurements
12. Tests for IP as per BOQ specifications

#### **4.7 WARRANTY**

All Luminaires and its gears along with LMS software & hardware shall carry replacement warranty for a period of 05 (Five) years from the date of commissioning.

### **5.0 MEDIUM VOLTAGE CABLES**

#### **5.1 GENERAL**

Technical specifications in this section covers supplying and laying of :

- Medium voltage cables.

#### **5.2 STANDARDS AND CODES**

All equipments, components, materials and entire work shall be carried out in conformity with applicable and relevant Bureau of Indian Standards and Codes of Practice, as amended upto date and as below. In addition, relevant clauses of the Indian Electricity Act 1910 and Indian Electricity Rules 1956 as amended upto date shall also apply. Wherever appropriate Indian Standards are not available, relevant British and /or IEC Standards shall be applicable.

Equipments certified by Bureau of Indian Standards shall be used in this contract in line with government regulations. Test certificates in support of this certification shall be submitted, as required.

It is to be noted that updated and current standards shall be applicable irrespective of dates mentioned along with ISS's in the tender documents.

PVC insulated heavy duty cables	IS 1554 - 1988
Cross link polyethylene insulated PVC (sheathed XLPE cables)	IS 7098 - 1985
Code of practice for installation and maintenance of power cables	IS 1255 - 1983
Conductors for insulated electrical cables	IS 8130 - 1984
Drums for electrical cable	IS 10418 - 1982
Methods of test for cables	IS 10810 - 1988
Recommended current rating	IS 3961 - 1987
Recommended short circuit rating of high voltage	IS 5891 - 1970

### 5.3 Medium Voltage Cables

Medium voltage cables shall be aluminium conductor XLPE insulated, PVC sheathed armoured conforming to IS 7098. Cables shall be rated for a 1100 Volts. The conductor of cables from 16 Sq. mm. to 50 Sq. mm. shall be stranded. Sector shaped stranded conductors shall be used for cables of 50 sq. mm and above. Conductors shall be made of electrical purity aluminium 3/4 H or H temper. Conductors shall be insulated with high quality PVC base compound. A common covering (bedding) shall be applied over the laid up cores by extruded sheath of unvulcanised compound. Armouring shall be applied over outer sheath of PVC sheathing. The outer sheath shall bear the manufacturer's name and trade mark at every metre length. Cores shall be provided with following colour scheme of PVC insulation.

1 Core	:	Red/Black/Yellow/Blue
2 Core	:	Red and Black
3 Core	:	Red, Yellow and Blue
3 1/2 /4 Core	:	Red, Yellow, Blue and Black

Current ratings shall be based on the following conditions.

a)	Maximum conductor temperature	70° C
b)	Ambient air temperature	45° C
c)	Ground temperature	30° C
d)	Depth of laying	1000 mm

Short circuit rating of cables shall be as specified in IS 7098.

Cables have been selected considering conditions of maximum connected loads, ambient temperature, grouping of cables and allowable voltage drop. However, the contractor shall recheck the sizes before cables are fixed and connected to service.

#### **5.4 Delivery, Storage and Handling**

Cable drum shall be stored on a well drained, hard surface, preferably of concrete, so that the drums do not sink in ground causing rot and damage to the cable drum. The cable drum shall conform to IS 10418. During storage, periodical rolling of drums, in the direction of arrow marked on the drum, shall be done once in 3 month through 90°C Both ends of cables shall be properly sealed to prevent moisture ingress Drums shall be stored in well ventilated area protected from sun and rain. Drums shall always be rested on the flanges and not on flat sides. Damaged battens of drums etc. shall be replaced. Movement of drums shall always be in direction of the arrow marked on the drum. For transportation over long distance, the drums shall either be mounted on drum wheels and pulled by ropes or they shall be mounted on trailers etc. drums shall be unloaded preferably by crane otherwise they shall be rolled down carefully on suitable ramps. While transferring cable from 1 drum to another, the barrel of the new drum shall have diameter not less than the original drum. Cables with kinks or similar visible defects like defective armouring etc shall be rejected. Cables shall be supplied at site in cut pieces as per actual requirements.

#### **5.5 LAYING OF CABLES**

Cables shall be so laid that the maximum bending radius is 12 times the overall diameter of the cable for medium voltage cables. Cables shall be laid in masonry trenches, directly on walls/cable trays, directly buried in ground or in pipes/ducts as elaborated below. Cables of different voltages and also power and control cables shall be laid in different trenches with adequate separation. Wherever available space is restricted such that this requirement cannot be met, medium voltage cables shall be laid above HT cables.

##### **a. In Masonry Trenches**

Wherever so specified, cables shall be laid in indoor/outdoor masonry/RCC trenches to be provided by Owners. Cables shall be laid on MS supports fabricated from minimum 38mm x 38mm x 6mm painted / galvanized angle iron supports grouted in trench walls at intervals not exceeding 600 mm. If required, cables shall be arranged in tier formation inside the trench. Suitable clamps, hooks and saddles shall be used for securing the cables in position and dressing properly so that the clear spacing between the cables shall not be less than the diameter of the cable. Trenches shall be provided with chequered plate/RCC covers. Wherever so specified, trenches shall be filled with fine sand.

##### **b. On Trays/Walls**

Wherever

so specified, cables shall be laid along walls/ceiling or on cable trays. Cable shall be secured in position and dressed properly by means of suitable clamps, hooks, saddles etc. such that the minimum clear spacing between cables is diameter of the cable. Clamping of cables shall be at minimum intervals as below.

Type of cables	Size	Clamping by	Fixing intervals
MV	Upto and including 25 sq mm	Saddles 1 mm thick	45 cm
MV & HV	35 sq mm to 120 sq mm	Clamps 3 mm thick 25 mm wide	60 cm
MV & HV	150 sq mm and above	Clamps 3 mm thick 40 mm wide	60 cm

Note :The fixing intervals specified apply to straight runs. In the case of bends, additional clamping shall be provided at 30 cm from the centre of the bend on both sides.

Cable trays, of sizes as per schedule of quantities and drawings shall be of perforated doubled bend channel/ladder design unless otherwise stated. Cable trays shall be fabricated from minimum 2 mm thick sheet steel and shall be complete with tees, elbows, risers, and all necessary hardware. Cable trays shall comply with the following:

Trays shall have suitable strength and rigidity to provide proper support for all contained cables. Trays shall not have sharp edges, burrs or projections injurious to cable insulation. Trays shall include fittings for changes in direction and elevation. Cable trays and accessories shall be painted with one shop coated of red oxide zinc chromate primer and two side coats of aluminium alkyd paint or approved equivalent. Cable trays shall not have sharp edges, burrs or projection that may damage the insulation jackets of the wiring. Cable trays shall have side rails or equivalent structural members.

Unless otherwise specifically noted on the relevant layout drawing, all cable tray mounting works to be carried out ensuring the following :

Cable tray mounting arrangement type to be as marked on layout drawing. Assembly of tray mounting structure shall be supplied fabricated, erected & painted by the electrical contractor. Tray mounting structures shall be welded to plate inserts or to structural beams as approved by the Architect/Engineer/DFCCIL. Wherever embedded plates & structural beams are not available for welding the tray mounting structure electrical contractor to supply the MS plates & fix them to floor slab by four anchor fasteners of minimum 16 mm dia having minimum holding power of 5000 Kg at no extra cost. Maximum loading on a horizontal support arm to be 120 Kg. metre of cable run. Width of the horizontal arms of the tray supporting structures to be same as the tray widths specified in tray layout drawings, plus length required, for welding to the vertical supports. The length of vertical supporting members for horizontal tray runs shall be to suit the number of tray tiers shown in tray layout drawings. Spacing between horizontal

supports arms of vertical tray runs to be 300 mm. Cable trays will be welded to their mounting supports. Minimum clearance between the top most tray tier and structural member to be 300 mm. Cables in vertical race ways to be clamped by saddle type clamps to the horizontal slotted angels. Clamps to be fabricated from 3 mm thick aluminium strip at site by the electrical contractor to suit cable groups. The structural steel (standard quality) shall be according to latest revision of IS : 226 & 808. Welding shall be as per latest revisions of IS : 816. All structural steel to be painted with one shop coat of red oxide and oil primer followed by a finishing coat of aluminium alkyd paint where any cuts or holes are made on finished steel work these shall be sealed against oxidation by red oxide followed by the same finishing paint. Steel sheet covers wherever indicated to be similarly painted. Trays shall be erected properly to present a neat and clean appearance. Trays shall be installed as a complete system. Trays shall be supported adequately by means of painted MS structural members secured to the structure by dash fasteners or by grouting. The entire cable tray system shall be rigid. Each run of cable tray shall be completed before laying of cables. Cable trays shall be erected so as to be exposed and accessible.

### **c. Buried Directly In Ground**

#### **General**

Cables shall be so laid that they will not interfere with under ground structures. All water pipes, sewage lines or other structures which become exposed by excavation shall be properly supported and protected from injury until the filling has been rammed solidly in places under and around them. Any telephone or other cables coming in the way are to be properly shielded as directed by Architects/Owners. Surface of the ground shall be made good so as to conform in all respects to the surrounding ground to the satisfaction of Architect/Engineer/DFCCIL.

#### **Routing of cables**

Before cable laying work is undertaken, the route of the cables shall be decided with the Architects/Owners. While shortest practicable route shall be preferred, cable runs shall follow fixed development such as roads, footpaths etc with proper off-sets so that future maintenance and identification are rendered easy. Whenever cables are laid along well demarcated or established roads, the LV/MV cables shall be laid further from the kerb line than HV cables. Cables of different voltages and also power and control cables shall be kept in different trenches with adequate separation. Where available space is restricted, LV/MV cables shall be laid above HV cables. Where cables cross one another, the cables of higher voltage shall be laid at a lower level than the cables of lower voltage. Power and communication cables shall as far as possible cross at right angles. Where power cables are laid in proximity to communications cables the horizontal and vertical clearances shall not normally be less than 60 cm.

#### **Width of Trench**

The width of trench shall be determined on the following basis. The minimum width of trench for laying single cables shall be 350 mm. Where more than one cable is to be laid in the same trench in horizontal formation, the width of trench shall be increased such that the inter-axial

spacing between the cables except where otherwise specified shall be at least 200 mm. There shall be a clearance of at least 150 mm between axis of the end cables and the sides of the trench.

### **Depth of Trench**

The depth of trench shall be determined on the following basis:

- Where cables are laid in single tier formation, the total depth of the trench shall not be less than 750 mm for cables upto 1.1 kV and 1250 mm for cables above 1.1 kV.
- When more than one tier of cables is unavoidable and vertical formation of laying is adopted, the depth of trench shall be increased by 300 mm for each additional tier to be formed.

### **Excavation Of Trenches**

The trenches shall be excavated in reasonably straight lines. Wherever there is a change in direction, suitable curvature of 12 times the overall diameter of the largest cable shall be provided. Where gradients and changes in depths are unavoidable these shall be gradual. Excavation should be done by any suitable manual or mechanical means. Excavated soil shall be stacked firmly by the side of the trench such that it may not fall back into the trench. Adequate precautions shall be taken not to damage any existing cables, pipes or other such installations during excavation. Wherever bricks, tiles or protected covers or bare cables are encountered, further excavation shall not be carried out without the approval of the Architect/Engineer/DFCCIL. Existing property exposed during trenching shall be temporarily supported or propped adequately as directed by the Architect/Engineer/DFCCIL. The trenching in such cases shall be done in short lengths, necessary pipes laid for passing cables therein and the trench refilled as required. If there is any danger of a trench collapsing or endangering adjacent structures the sides shall be well shored up with timbering and/or sheathing as the excavation proceeds. Where necessary these may even be left in place when back filling the trench. Excavation through lawns shall be done in consultation with the Architect/Engineer/DFCCIL. Bottom of the trench shall be level and free from stone, brick, etc. The trench shall then be provided with a layer of clean dry sand cushion of not less than 80 mm in depth.

#### **d. Laying Of Cable In Trench**

The cable drum shall be properly mounted on jacks or on a cable wheel at a suitable location. It should be ensured that the spindle, jack etc are strong enough to carry the weight of the drum without failure and that the spindle is horizontal in the bearings so as to prevent the drum creeping to one side while rotating. The cable shall be pulled over rollers in the trench steadily and uniformly without jerks or strains. The entire cable length shall, as far as possible, be laid in one stretch. However when this is not possible the remainder of the cable shall be removed by flaking i.e. making one long loop in the reverse direction. After the cable is uncoiled and laid over the rollers, the cable shall be lifted slightly over the rollers beginning from one end by helpers standing about 10 metres apart and drawn straight. The cable should then be taken off

the rollers by additional helpers lifting the cables and then laid in the trench in a reasonably straight line. For short runs and cable sizes upto 50 sq mm 1.1 kV grade the alternative method of direct handling can be adopted with the prior approval of the Architect/Engineer/DFCCIL. If two or more cables are laid in the same trench care should be taken to preserve relative position. All the cables following the same routes shall be laid in the same trench. Cables shall not cross each other as far as possible. When the cable has been properly straightened the cores shall be tested for continuity and insulation resistance. The cable shall be measured thereafter. Suitable moisture sealing compound/tape shall be used for sealing of the ends. Cable laid in trenches in a single tier formation shall have a covering of clean dry sand of not less than 170 mm above the base cushion of sand before the protective cover is laid. In the case of vertical multi-tier formation after the first cable has been laid a sand cushion of 300 mm shall be provided over the initial bed before the second tier is laid. If additional tiers are formed each of the subsequent tiers also shall have a sand cushion of 300 mm. The top most cable shall have a final sand covering not less than 170 mm before the protective cover is laid. A final protection to cables shall be laid to provide warning to future excavators of the presence of the cable and also to protect the cables against accidental mechanical damage. Such protection shall be with second class bricks of not less than 200 mm x 100 mm x 100 mm (normal size) laid breadth wise for the full length of the cable to the satisfaction of the Architect/Engineer/DFCCIL. Where more than one cable is to be laid in the same trench this protective covering shall cover all the cables and project at least 50 mm over the sides of the end cables. In addition bricks on edge shall be placed along the entire run on either side of the cable run. The trenches shall then be back filled with excavated earth free from stones or other sharp edged debris and shall be rammed and watered in successive layers not exceeding 300 mm. Unless otherwise specified a crown of earth not less than 50 mm in the centre and tapering towards the side of the trench shall be left to allow for subsidence. The crown of earth should however not exceed 100 mm so as not to be a hazard to vehicular traffic. Where road berms or lawns have been cut or kerb stones displaced the same shall be repaired and made good to the satisfaction of the Architect/Engineer/DFCCIL and all surplus earth and rocks removed to places as specified.

#### **e. Laying In Pipes/Closed Ducts**

In locations such as road crossings, entry to buildings/poles in paved areas etc., cables shall be laid in pipes or closed ducts. Spun reinforced concrete pipes shall be used for such purposes and the pipe shall not be less than 100 mm in diameter for a single cable and not less than 150 mm for more than one cable. These pipes shall be laid directly in ground without any special bed. Sand cushioning and/or brick tiles need not be used in such installations. Unless otherwise specified the top surface of pipes shall be at a minimum depth of 1000 mm from the ground level when laid under roads, pavements etc. The pipes for road crossings shall preferably be on the skew to reduce the angle of bend as the cable enters and leaves the crossing. Pipes shall be continuous and clear of debris or concrete before cable is drawn. Sharp edges at ends shall be smoothened to prevent injury to cable insulation or sheathing. No deduction shall be made for sand and bricks not used for cables passing through RCC Hume pipes or for parts of vertical cables at the lighting poles.

**f. Laying Of Cables In Floors**

Laying of cables directly in floors shall be avoided and GI pipes of adequate size shall be used wherever necessary. However if the cables have to be laid direct in the floor specific written approval of Architect/Engineer/DFCCIL shall be obtained and the Contractor shall cut chases, lay the cables and make good the chases to original finish.

**g. Cable Entry Into Buildings**

Cable entry into buildings shall be made through RCC pipes recessed in the floor. RCC Hume pipes shall be provided well in advance for service cable entries. The pipe shall be filled with sand and sealed at both ends with bitumen mastic to avoid entry of water. Suitable size manholes shall be provided wherever required to facilitate drawing of cables as per requirements.

**5.6 TERMINATION/JOINTING OF CABLES**

Soldered jointing/termination shall be totally avoided. Solderless terminations by using Dowel crimping tools and suitable legs shall be adopted for all cable terminations. Any terminations may without use of proper crimping tool is shall be liable to be rejected. In the case of aluminium conductors, it is to be ensured that the conductor oxidation is cleaned by means of emery paper and then a thin coat of tin is applied before pinching into any equipment. Heat shrinkable Raychem type or approved equivalent terminations shall be provided for High Voltage cables and Siemens make or approved equivalent make brass double compression glands shall be provided for Medium Voltage cable terminations. Straight through jointing of Medium Voltage or High Voltage cable shall normally be totally avoided. If absolutely unavoidable, such jointing shall be carried out as per procedure to be got specifically approved from Architect/Engineer/DFCCIL.

**5.7 MEASUREMENT OF CABLE RUNS**

The cable runs shall be measured upto the outer end of the boxes without any allowances for over lap in joints. The actual run of the cables shall be measured and the rate shall include all the above mentioned material, labour etc for laying as required.

**5.8 CABLE LOOPS**

At the time of the installation approximately 3 metres of surplus cable shall be left

- at each end of the cable
- on each side of underground straight through/tee/termination joints.
- at entries to buildings
- and such other places as may be decided by the architects/owners.

This cable shall be left in the form of a loop.



Wherever long runs of cable length are installed cable loops shall be left at suitable intervals as specified by the Architect/Engineer/DFCCIL.

## **5.9 BONDING OF CABLES.**

Where a cable enters any piece of apparatus it shall be connected to the casting by means of an approved type of armoured clamp or gland. The clamps must grip the armouring firmly to the gland or casting, so that in the event of ground movement no undue stress is placed on to the cable conductors.

## **5.10 TESTING**

### **a. Tests At Manufacturer's Work**

The cables shall be subjected to shop test in accordance with relevant standards to prove the design and general qualities to the cables as below (as per IS 10810) :

- Routine test on each drum of cables.
- Acceptance tests on drums chosen at random for acceptance of the lot.
- Type test on each type of cables, inclusive of measurement of armour DC resistance of power cables.

### **b. Site Testing**

- All cables before laying shall be tested with a 500 V megger for 1.1 kV grade or with a 2500/5000 V megger for cables of higher voltages. The cables cores shall be tested for continuity, absence of cross phasing, insulation resistance to earth/sheath/armour and insulation resistance between conductors.
- All cables shall be subject to above mentioned test during laying, before covering the cables by protective covers and back filling and also before the jointing operations.
- After laying and jointing, the cable shall be subjected to a 1.5 minutes AC/DC pressure test.
- In the absence of facilities for pressure testing in accordance with clause\_\_ above it is sufficient to test for one minute with 1000 V megger for cables of 1.1 kV grade and with 2500/5000 V megger for cables of higher voltages.

### **c. Test Witness**

Tests shall be performed in presence of representative of Architect/Engineer/DFCCIL. The Contractor shall give at least fifteen (15) days advance notice of the date when the tests are to be carried out.

## **6.0 MEDIUM VOLTAGE SWITCHGEAR**

### **6.1 GENERAL**

This section covers specification of Medium Voltage Switchboards incorporating items of switchgear like Circuit Breakers, SFUs, metering and protection.

## 6.2 STANDARDS AND CODES

The following Indian Standard Specifications and Codes of Practice will apply to the equipment and the work covered by the scope of this contract. In addition the relevant clauses of the Indian Electricity Act 1910 and Indian Electricity Rules 1956 as amended upto date shall also apply. Wherever appropriate Indian Standards are not available, relevant British and/or IEC Standards shall be applicable.

BIS certified equipment shall be used as a part of the Contract in line with Government regulations. Necessary test certificates in support of the certification shall be submitted prior to supply of the equipment.

It is to be noted that updated and current Standards shall be applicable irrespective of those listed below.

Low Voltage switchgear & controlgear	IS 13947 : 1993
Part I : General rules	
Part II : Circuit Breakers	
Part III : Switches, disconnectors, switch disconnectors and fuse combination units	
Part IV : Contactors and Motor starters	
Part V : Control circuit devices and switching elements	
Marking of Switchgear busbars	IS 11353 : 1985
Degree of Protection of Enclosures for low voltage switchgear.	IS 2147 : 1962
Electrical relays for power system protection	IS 3231 : 1986
Code of Practice for selection, installation and	IS 10118 : 1982
Maintenance of switchgear & controlgear	
Low voltage switchgear & controlgear assemblies	IS 8623 : 1993

## 6.3 SWITCHGEAR

### 6.3.1 Moulded Case Circuit Breakers

Moulded case circuit breakers (MCCB) incorporated in switchboards wherever required, shall conform to IS 13947 : 1993 in all respects. MCCBs shall be suitable either for single phase 240 Volts or 3 Phase 415 Volts AC 50 Hz supply.

MCCB cover and case shall be made of high strength heat resisting and flame retardant thermosetting insulating material. Operating handle shall be quick make/break, trip - free type. Operating handle shall have suitable ON, OFF and TRIPPED indicators. Three phase MCCBs shall have a common handle for simultaneous operation and tripping of all the three phases. Suitable arc extinguishing device shall be provided for each contact. Tripping unit shall be of thermal/magnetic type provided on each pole and connected by a common tripe bar such that tripping of any one pole causes three poles to open simultaneously. Thermal/magnetic tripping device shall have IDMT characteristics for sustained over loads and short circuits.

Contact trips shall be made of suitable arc resistant sintered alloy. Terminals shall be of liberal design with adequate clearances.

MCCBs shall be provided with following accessories, if specified in drawings/ schedule of quantities :

- Under voltage trip
- Shunt trip
- Alarm switch
- Auxiliary switch

MCCBs shall be provided with following interlocking devices for interlocking the door a switch board.

- Handle interlock to prevent unnecessary manipulations of the breaker.
- Door interlock to prevent door being opened when the breaker is in ON position
- Deinterlocking device to open the door even if the breaker is in ON position.

MCCBs shall have rupturing capacity as specified in drawings/schedule of quantities.

All MCCB shall be provided with adapter terminal for facilitates higher sizes of cable/ links

### **6.3.2 Metering, Instrumentation And Protection.**

Ratings, type and quantity of meters, instruments and protective devices shall be as per drawings and schedule of quantities.

### **6.3.3 Current Transformers**

C/Ts shall confirm to IS 2705 (part -I, II and III) in all respects. All C/Ts used for medium voltage application shall be rated for 1 kV. C/Ts shall have rated primary current, rated burden and class of accuracy as specified in schedule of quantities/drawings. Rated secondary current shall be 5A unless otherwise stated. Minimum acceptable class for measurement shall be class 0.5 to 1 and for protection class 10. C/Ts shall be capable of withstanding magnetic and thermal

stresses due to short circuit faults of 31 MVA on medium voltage. Terminals of C/Ts shall be paired permanently for easy identification of poles. C/Ts shall be provided with earthing terminals for earthing chassis, frame work and fixed part of metal casing (if any). Each C/T shall be provided with rating plate indicating :

- Name and make
- Serial number
- Transformation ratio
- Rated burden
- Rated voltage
- Accuracy class

CTs shall be mounded such that they are easily accessible for inspection, maintenance and replacement. Wiring for CT shall be with copper conductor PVC insulated wires with proper termination works and wiring shall be bunched with cable straps and fixed to the panel structure in a neat manner.

#### **6.3.4 Potential Transformer**

PTs shall conform to IS 3156 (Part-I,II and III) in all respects.

#### **6.3.5 Measuring Instruments**

Direct reading electrical instruments shall conform to IS 1248 or in all respects. Accuracy of direct reading shall be 1.0 of voltmeter and 1.5 for ammeters. Other instruments shall have accuracy of 1.5. Meters shall be suitable for continuous operation between  $-10^{\circ}\text{C}$  to  $+50^{\circ}\text{C}$ . Meters shall be flush mounting and shall be enclosed in dust tight housing. The housing shall be of steel or phenolic mould. Design and manufacture of meters shall ensure prevention of fogging of instrument glass. Pointer shall be black in colour and shall have Zero position adjustment device operable from out side. Direction of deflection shall be from left to right. Selector switches shall be provided for ammeters and volt meters used in three phase system.

#### **6.3.6 Multi Function meters**

MFM shall be employed on the Panels and DBs as specified in the BOQ. MFM shall have seamless integration with BMS and shall supply all data with suitable means. All parameters shall be made available to BMS. Meters shall be suitable for operation with current and potential transformers available in the panel.

#### **6.3.7 Relays**

Protection relays shall be provided with flag type indicators to indicate cause of tripping. Flag indicators shall remain in position till they are reset by hand reset. Relays shall be designed to make or break the normal circuit current with which they are associated. Relay contacts shall be of silver or platinum alloy and shall be designed to withstand repeated operation without damage. Relays shall be of draw out type to facilitate testing and maintenance. Draw out case

shall be dust tight. Relays shall be capable of disconnecting faulty section of network without causing interruption to remaining sections. Analysis of setting shall be made considering relay errors, pickup and overshoot errors and shall be submitted to Architect/Engineer/DFCCIL for approval.

#### **6.3.8 Over current relays**

Over current relays shall be induction type with inverse definite minimum time lag characteristics. Relays shall be provided with adjustable current and time settings. Setting for current shall be 50 to 200 % insteps of 25%. The IDMT relay shall have time lag (delay) of 0 to 3 seconds. The time setting multiplier shall be adjustable from 0.1 to unity. Over current relays shall be fitted with suitable tripping device with trip coil being suitable for operation on 5 Amps.

#### **6.3.9 Earth fault relay**

Same as over current relay excepting the current setting shall be 10% to 40% in steps of 10%.

#### **6.3.10 Under voltage relay**

Under voltage relays shall be of induction type and shall have inverse limit operation characteristics with pickup voltage range of 50 to 90% of the rated voltage.

## **7 MEDIUM VOLTAGE DISTRIBUTION BOARDS**

### **7.1 GENERAL**

This section covers specification of DBs.

### **7.2 STANDARDS AND CODES**

The following Indian Standard Specifications and Codes of Practice will apply to the equipment and the work covered by the scope of this contract. In addition the relevant clauses of the Indian Electricity Act 1910 and Indian Electricity Rules 1956 as amended upto date shall also apply. Wherever appropriate Indian Standards are not available, relevant British and/or IEC Standards shall be applicable.

BIS certified equipment shall be used as a part of the Contract in line with Government regulations. Necessary test certificates in support of the certification shall be submitted prior to supply of the equipment.

It is to be noted that updated and current Standards shall be applicable irrespective of those listed below.

Miniature Air Circuit Breakers for AC circuits

IS 8828 : 1978

Degrees of Protection provided by enclosures IS 2147 : 1962

for low voltage switchgear

Code of Practice for installation and maintenance IS 10118 : 1982

of switchgear not exceeding 1000 volts

General requirements for switchgear and controlgear IS 4237 : 1982

for voltages not exceeding 1000 volts

### **7.3 FINAL DISTRIBUTION BOARDS**

- Final distribution boards shall be flush mounting, totally enclosed, dust and vermin proof and shall comprise of miniature circuit breakers, earth leakage circuit breakers, neutral link etc as detailed in the schedule of quantities.
- The distribution equipment forming a part of the Distribution Boards shall comply to the relevant Standards and Codes of the Bureau of Indian Standards and as per detailed specifications included in this tender document.
- The board shall be fabricated from 14 gauge CRCA sheet steel and shall have a hinged lockable spring loaded cover. All cutouts and covers shall be provided with synthetic rubber gaskets. The entire construction shall give a IP 42 degree of protection.
- The bus-bar shall be of electrical grade copper having a maximum current density of 1.6 ampere per square mm and PVC insulated throughout the length.
- All the internal connections shall be with either solid copper PVC insulated or copper conductor PVC insulated wires of adequate rating.
- All the internal connections shall be concealed by providing a hinged protective panel to avoid accidental contact with live points.
- All outgoing equipment shall be connected direct to the bus bar on the live side. The equipment shall be mounted on a frame work for easy removal and maintenance.
- The sheet steel work shall undergo a rigorous rust proofing process, two coats of filler oxide primer and final powder coated paint finish.
- All the circuits shall have an independent neutral insulated wire, one per circuit, and shall be numbered and marked as required by the Architect/Engineer/DFCCIL.
- A sample of the completed board is to be got approved by the architects/owners before commencement of supply and erection.

### **7.4 SHEET STEEL TREATMENT AND PAINTING**

- Sheet Steel materials used in the construction of these units should have undergone a rigorous rust proofing process comprising of alkaline degreasing, descaling in dilute sulphuric acid and a recognised phosphating process. The steel work shall then receive two coats of oxide filler primer before final painting. Castings shall be scrupulously cleaned and fettled before receiving a similar oxide primer coat.
- All sheet steel shall after metal treatment be given powder coated finish painted with two coats of shade 692 to IS 5 on the outside and white on the inside. Each coat of paint shall be properly stoved and the paint thickness shall not be less than 50 microns.

## **7.5 NAME PLATES AND LABELS**

- Suitable engraved white on black name plates and identification labels of metal for all Switch Boards and Circuits shall be provided. These shall indicate the feeder number and feeder designation.

## **8 Conduit, Cable Tray and Raceway**

### **8.1 Scope**

The Contractor shall supply and install the conduits, cable trays and raceways as indicated in BOQ and specified herein.

### **8.2 Applicable Codes and Standards**

The conduits, cable trays and raceways shall comply with the following codes and standards:

IS: 9537 P-I:1980	: Conduits for Electrical Wiring Part I General Requirements
IS: 9537 P-II: 1981	: Conduits for electrical wiring Part II Rigid Steel Conduits
IS: 3837	: Accessories for Rigid Steel Conduits for Electrical Wiring
IS: 3480	: Flexible Steel Conduits for Electrical Wiring
IS: 732	: Code of Practice for Electrical Wiring Installations
IS: 2667	: Fittings for Rigid Steel Conduits for Electrical Wiring
IS 9537 : Part 1	: 1980/IEC 60614-1 (1978) : Conduits for electrical installations: Part 1 General requirements
IS 9537 : Part 2	: 1981(superseding IS:1653) : Conduits for electrical installations: Part 2 Rigid steel conduits
IS: 3837:1976	: Accessories for rigid steel conduits for electrical wiring
IS: 3480:1966	: Flexible steel conduits for electrical wiring
IS: 732: 1989	: Code of practice for electrical wiring installations

IS: 2667-1988 : Fittings for rigid steel conduits for electrical wiring

IS: 2412-1975 : Link clips for electrical wiring

IS:371-1999 : Ceiling roses

In addition to above, Indian Electricity Act 2003 and IE Rules 1956 as amended from time to time, General Specifications for electrical works Part-1 internal-2005 issued by CPWD shall be followed.

### **8.3 Material Description**

The conduit, cable tray and raceway shall be designed and manufactured in accordance to the Indian Standards or International Standards and accepted by the authority and shall be installed to comply with relevant provision in Indian Standards Specifications, Indian Electricity Rules and IE wiring regulation.

### **8.4 Components**

#### **(1) GI Conduits and Accessories**

- a. The steel conduits shall be made of hot-dip galvanized, produced in electrical resistance welding process with the weld bead on both inside and outside removed in accordance with Indian standard IS:9537 part 3 or equivalent.
- b. Flexible conduit and fittings for life safety equipment shall be galvanized, watertight pattern, flame retardant, Low smoke and fume, over-sheathed and separate earth wire enclosed within the conduit (if applicable).
- c. The standard manufactured elbows shall be used for all sizes of conduits diameter larger than 1 inch (25mm), and the field bends to be handled with great care not to damage the conduits, shall be permitted to be used for conduit of 1 inch and smaller.
- d. The conduits shall be defined in SI units.

#### **(2) Cable Tray**

- a. Cable trays used in indoors shall be made of hot dip galvanized perforated steel after fabrication to provide good corrosion resistance during storage, installation and service. The ventilated type cable tray, punching with cover shall be provided with the dimensions as indicated on the drawings.
- b. The number of cables laid in the cable tray shall be provided in compliance in compliance with the requirements of the Indian Standard Specifications, Indian Electricity Rules and IE wiring regulations. 40% spare capacity shall be provided for cable laying inside the cable tray.
- c. Cable tray shall not be installed across building or structural expansion joints. On horizontal runs, the tray shall be installed with a 20 mm gap at the expansion joint. Support shall be installed within 150 mm on either side of the joint.
- d. Wherever cables are laid in cable trays these shall be concealed above false ceiling. Trays shall conform to NEMA with minimum 2.0 mm thickness, perforated and galvanized steel.

#### **(3) Raceway**



- a. Raceways shall be made of hot dip galvanized perforated steel after fabrication to afford good corrosion resistance during storage, installation and service life and shall be provided to form the continuous steel sheet troughs with removable covers attached to the race way by screws for housing the cables. The minimum thickness required for raceway shall be as per the following table:

Size of the Raceway (WXH) (mm)	Thickness (mm)
50X50 up to 100X50	1.6
100X100 up to 150X100	1.6
200X100 up to 300X100	1.6
150X150 up to 300X150	1.6
Larger than above	2.0

- b. Raceways shall be installed so that all networking/telecom cables are separate from power cables.
- c. Each section of the raceway shall be electrically bonded with a minimum 6 mm<sup>2</sup> cross section area earth bonding strap or wire, to the next section to form an electrically continuous system and bonding to main grounding system shall be with copper green/yellow, LSZH material sheathed single core cable.
- d. The number of cables laid in the cable tray shall be provided in compliance with the requirements of the Indian Standard Specifications, Indian Electricity Rules and IE wiring regulations. 40% spare capacity shall be provided for cable laying inside the raceway.

#### **(4) Boxes and Accessories**

- a. All boxes provided in the conduit work shall be made of metal. A box provided for cable connections and concealed in ceiling shall be a standard galvanized steel square or circular box or a metal box, made of steel sheet with not less than 1.6 mm thickness, with one primer anti-rust coated and two coating finishes.
- b. All wall/ceiling boxes on exposed work shall be of die cast aluminium or cadmium-plated cast-iron.
- c. Conduit outlet boxes, for socket outlets, lighting switches, etc., shall be of hot dip galvanized steel complete with adjustable lug, ample knockouts, and brass earth terminals fitted in the base.

### **8.5 Testing and Commissioning**

Field inspection and testing for conduit, cable tray and raceways installed shall be carried out prior to energization of any equipment / system.

## **9 MEDIUM VOLTAGE SWITCH BOARDS**

### **9.1 General**

- All medium voltage switchboards shall be suitable for operation at three phase/three phase 4 wire, 415 volt, 50 Hz, neutral grounded at transformer system with a short circuit level withstand of 25 MVA at 415 volts or as per schedule of quantities.
- The Switch Boards shall comply with the latest edition with upto date amendments of relevant Indian Standards and Indian Electricity Rules and Regulations.

### **9.2 Switch Board Configuration**

- The Switch Board shall be configured with Air Circuit Breakers, MCCB's, and other equipment as called for in the Schedule of Quantities.

- The MCCB's shall be arranged in multi-tier formation whereas the Air Circuit Breakers shall be arranged in Single or Double tier formation only to facilitate operation and maintenance.
- The Switch Boards shall be of adequate size with a provision of 25% spare space to accommodate possible future additional switch gear.

### **9.3 Equipment Specifications**

All equipment used to configure the Switch Board shall comply to the relevant Standards and Codes of the Bureau of Indian Standards and to the detailed technical Specifications as included in this tender document.

### **9.4 Constructional Features**

- The Switch Boards shall be metal enclosed, sheet steel cubicle pattern, extensible, dead front, floor mounting type and suitable for indoor mounting.
- The Switch Boards shall be totally enclosed, completely dust and vermin proof. Synthetic rubber gaskets between all adjacent units and beneath all covers shall be provided to render the joints dust and vermin proof to provide a degree of protection of IP 54. All doors and covers shall also be fully gasketed with synthetic rubber and shall be lockable.
- The Switch Board shall be fabricated with CRCA Sheet Steel of thickness not less than 2.0 mm and shall be folded and braced as necessary to provide a rigid support for all components. The doors and covers shall be constructed from CRCA sheet steel of thickness not less than 1.6 mm. Joints of any kind in sheet metal shall be seam welded and all welding slag ground off and welding pits wiped smooth with plumber metal.
- All panels and covers shall be properly fitted and square with the frame. The holes in the panel shall be correctly positioned.
- Fixing screws shall enter holes tapped into an adequate thickness of metal or provided with hank nuts. Self threading screws shall not be used in the construction of the Switch Boards.

Panel mounted lock to be provided on each compartment.

### **9.5 Switchboard Dimensional Limitations**

- A base channel 75mm x 40mm x 5mm shall be provided at the bottom.
- A minimum of 200 mm blank space between the floor of switch board and bottom most unit shall be provided.
- The overall height of the Switch Board shall be limited to 2300 mm
- The height of the operating handle, push buttons etc shall be restricted between 300 mm and 2000 mm from finished floor level.

### **9.6 Switch Board Compartmentalisation**

The Switch Board shall be divided into distinct separate compartments comprising

- A completely enclosed ventilated dust and vermin proof bus bar compartment for the horizontal and vertical busbars.
- Each circuit breaker, and MCCB shall be housed in separate compartments enclosed on all sides.
- Sheet steel hinged lockable doors for each separate compartment shall be provided and duly interlocked with the breaker/switch fuse unit in "on" and "off" position.
- For all Circuit Breakers separate and adequate compartments shall be provided for accommodating instruments, indicating lamps, control contactors and control fuses etc. These shall be accessible for testing and maintenance without any danger of accidental contact with live parts of the circuit breaker, busbars and connections.
- A horizontal wire way with screwed cover shall be provided at the top to take interconnecting control wiring between vertical sections.
- Separate cable compartments running the height of the Switch Board in the case of front access Boards shall be provided for incoming and outgoing cables.
- Cable compartments shall be of adequate size for easy termination of all incoming and outgoing cables entering from bottom or top.
- Adequate and proper support shall be provided in cable compartments to support cables.

#### **9.7 Switch Board Bus Bars**

- The Bus Bar and interconnections shall be of Aluminium and of rectangular cross sections suitable for full load current for phase bus bars and half rated current for neutral bus bar. Aluminium shall be 1/1 amp per Sq. mm. and suitable to withstand the stresses of a 25 MVA fault level or at 415 volts for 1 second or as per schedule of quantities. .
- The bus bars and interconnections shall be insulated with insulation tape/ fiber glass.
- The bus bars shall be extensible on either side of the Switch Board.
- The bus bars shall be supported on non-breakable, non-hygroscopic insulated supports at regular intervals, to withstand the forces arising from a fault level of 31 MVA at 415 volts for 1 second.
- All bus bars shall be colour coded.
- All bus bar connections in Switch Boards shall be bolted with brass bolts and nuts. Additional cross section of bus bars shall be provided wherever holes are drilled in the bus bars.

#### **9.8 Switch Board Interconnections**

- All connections between the bus bars/Breakers/cable terminations shall be through solid copper strips of adequate size to carry full rated current and PVC/fibre glass insulated.

- For unit ratings upto 100 amps PVC insulated copper conductor wires of adequate size to carry full load current shall be used. The terminations of all such interconnections shall be crimped.

## **9.9 Drawout Features**

Air Circuit Breakers shall be provided in fully drawout cubicles. These cubicles shall be such that drawout is possible without disconnection of the wires and cables. The power and control circuits shall have self aligning and self isolating contacts. The fixed and moving contacts shall be easily accessible for operation and maintenance. Mechanical interlocks shall be provided on the drawout cubicles to ensure safety and compliance to relevant Standards. The MCCB's shall be provided in fixed type cubicles.

## **9.10 Instrument Accommodation**

- Instruments and indicating lamps shall not be mounted on the Circuit Breaker Compartment door for which a separate and adequate compartment shall be provided and the instrumentation shall be accessible for testing and maintenance without danger of accidental contact with live parts of the Switch Board.
- For MCCB's instruments and indicating lamps can be provided on the compartment doors.
- The current transformers for metering and for protection shall be mounted on the solid copper/aluminium busbars with proper supports.

## **9.11 Wiring**

All wiring for relays and meters shall be with FRLS insulated copper conductor wires. The wiring shall be coded and labelled with approved ferrules for identification. The minimum size of copper conductor control wires shall be 1.5 sq. mm.

## **9.12 Cable Terminations**

- Knockout holes of appropriate size and number shall be provided in the Switch Board in conformity with the location of incoming and outgoing conduits/cables.
- The cable terminations of the Circuit Breakers shall be brought out to terminal cable sockets suitably located at the rear of the panel.
- The cable terminations for the MCCB's shall be brought out to the rear in the case of rear access switchboards or in the cable compartment in the case of front access Switch Boards.
- The Switch Boards shall be complete with tinned brass cable sockets, tinned brass compression glands, gland plates, supporting clamps and brackets etc for termination of 1100 volt grade aluminium conductor PVC/PVCA cables.

## **9.13 Earthing**

A main earth bar of G.I./copper as required shall be provided throughout the full length of the Switch Board with a provision to make connections to the sub-station earths on both sides.

#### **9.14 Sheet Steel Treatment And Painting**

- Sheet Steel materials used in the construction of these units should have undergone a rigorous rust proofing process comprising of alkaline degreasing, descaling in dilute sulphuric acid and a recognised phosphating process. The steel work shall then receive two coats of oxide filler primer before final painting. Castings shall be scrupulously cleaned and fettled before receiving a similar oxide primer coat.
- All sheet steel shall after metal treatment be spray or powder painted with two coats of shade 692 to IS 5 on the outside and white on the inside. Each coat of paint shall be properly stoved and the paint thickness shall not be less than 50 microns.

#### **9.15 Name Plates And Labels**

Suitable engraved white on black name plates and identification labels of metal for all Switch Boards and Circuits shall be provided. These shall indicate the feeder number and feeder designation.

#### **9.16 Installation**

The foundations prepared as per the manufacturers drawings shall be levelled, checked for accuracy and the Switch Board installed. All bus bar connections shall be checked with a feeler gauge after installation. The cable end boxes shall be sealed to prevent entry of moisture. The main earth bar shall be connected to the sub-station earths.

A 15mm thick rubber matting of approved make on a 100 mm high timber platform shall be provided in front of and along the full length of the Switch Board. The width of the matting shall be 1000mm. The rubber mat shall withstand 15 KV for 1 minute and leakage current shall not exceed 160 mA/sq. metre.

After installation the Switch Board shall be tested as required prior to commissioning.

#### **9.17 Testing & Commissioning at site by third party**

- a) Alignment of panel, interconnection of Bus bars and tightness of bolts and connection.
- b) Inter panel wiring
- c) Free movement of ACB/MCCB/SFU
- d) Operation of breakers
- e) Insulation Tests
- f) Primary & secondary injection tests of relays.
- g) Interlocking function.

### **10 EARTHING**

#### **10.1 GENERAL**

All the non-current carrying metal parts of electrical installation shall be earthed properly. All metal conduits, trunking, cable sheaths, switchgear, distribution fuse boards, light fittings and all other parts made of metal shall be bonded together and connected by means of specified earthing

conductors to an efficient earthing system. All earthing shall be in conformity with Indian Electricity Rules.

The Earthing System shall in totally comprise the following:-

- (a) Earth Electrodes
- (b) Earthing Leads
- (c) Earth Conductors

All three phase equipment shall have two separate and distinct body earths and single phase equipment shall have a single body earth.

## **10.2 STANDARDS**

All equipments, components, materials and entire work shall be carried out in conformity with applicable and relevant Bureau of Indian Standards and Codes of Practice, as amended upto date and as below. In addition, relevant clauses of the Indian Electricity Act 1910 and Indian Electricity Rules 1956 as amended upto date shall also apply. Wherever appropriate Indian Standards are not available, relevant British and /or IEC Standards shall be applicable.

Equipments certified by Bureau of Indian Standards shall be used in this contract in line with government regulations. Test certificates in support of this certification shall be submitted, as required.

It is to be noted that updated and current standards shall be applicable irrespective of dates mentioned along with ISS's in the tender documents.

## **10.3 EARTHING MATERIAL**

Materials of which the protective system is composed shall be resistant to corrosion or be adequately protected against corrosion. The material shall be as specified in the schedule of quantities and shall comply to the following requirements:

- Copper - When solid or stranded copper wire is used it shall be of the grade ordinarily required for commercial electrical work generally designated as being of 98% conductivity when annealed, conforming to Indian standard specifications.
- Galvanised Steel - Galvanised steel used shall be thoroughly protected against corrosion by hot dipped Zinc coating. The material coating shall withstand the test specified in IS 2309:1969.
- The strips to be used shall be in maximum lengths available as manufactured normally avoiding unnecessary joints.

## **10.4 EARTH ELECTRODES**

### **Plate Earth Electrode**

The plate electrodes shall be of copper/ GI as called for in the schedule of quantities. The minimum dimensions of the electrodes shall be 600 mm x 600 mm. Thickness of copper electrodes shall not be less than 3 mm and of GI electrodes not less than 6 mm.

The electrode shall be buried in ground with its face vertical and top not less than 4 metre below ground level.

### **10.5 Earth Electrode Pit**

#### **Method of Installing Watering Arrangement**

In the case of plate earth electrode, a watering pipe of 20 mm dia of medium class G.I. Pipe shall be provided and attached to the electrode. A funnel with mesh shall be provided at the top of this pipe for watering the earth. The watering funnel attachment shall be housed in masonry enclosure of not less than 300 x 300 x 300mm. A RCC frame base with removable RCC cover slab M-25-4nos- 10mm dia -M.S. reinforcements bar at top & bottom both way shall be suitably embedded in the masonry enclosure

### **10.6 Location Of Earth Electrode**

The following guidelines shall be followed for locating the earth electrodes

An earth electrode shall not be situated less than 2 metres from any building.

The excavations for electrode shall not affect the column footings or foundations of the buildings. In such cases electrode may be further away from the building.

The location of the earth electrode shall be such where the soil has reasonable chance of remaining moist, as far as possible.

Entrances, pavements and road ways shall not be used for locating the earth electrode.

### **10.7 Number Of Earth Electrodes**

In all cases the relevant provision of rule 33, 61 & 67 of the Indian Electricity Rules 1956 as amended shall be complied with.

Metallic covers or supports of all medium or H.T. apparatus or conductors shall, in all cases be connected to not less than two separate and distinct earth electrodes.

### **10.8 EARTHING LEADS**

The strip earthing leads shall be connected to the Earth Electrode at one end and to the metallic body of the main equipment at the other end. The earthing lead shall connect to the earthing network in the installation.

### **10.9 PROHIBITED CONNECTIONS**

Neutral conductor, sprinkler pipes, or pipes conveying gas, water, or inflammable liquid, structural steel work, metallic enclosures, metallic conduits and lighting protection system conductors shall not be used as a means of earthing an installation or even as a link in an earthing system.

### **10.10 RESISTANCE TO EARTH**

No earth electrode shall have a greater ohmic resistance than 1 ohms as measured by an approved earth testing apparatus. In rocky soil the resistance may be upto one ohms. The electrical resistance measured between earth connection at the main switchboard and any other point on the completed installation shall be low enough to permit the passage of current necessary to operate fuses or circuit breakers, and shall not exceed one ohm.

### **Earthing System – specification**

Earthing system should comply to the requirements specified below. Earthing system should offer a resistance less than 5 ohms throughout the year. In places where Soil resistivity is more, multiple earth electrodes are to be installed to get the required value. Length of the earthing rod also can be increased to achieve low and stable resistance value.

Solid rods are recommended as earth electrode than a pipe due to the fact that solid rods can be easily driven by hydraulic hammers. Deep driven rods provide more stable and less Earth Resistance. Doubling the length of the rod will reduce earth resistance up to 40 %, where as doubling the diameter will reduce the resistance by only 10 %, but may increase the cost by 4 times. Lower earth resistance can also be achieved by increasing the number of earth rods. E.g. 40 % reduction in earth resistance is possible if the rods are increased from 1 to 2. The minimum spacing between earth pits should be equal to the length of the rod. Increasing the spacing between earth pits also reduces the earth resistance significantly.

### ***Need and importance of Earthing:***

- Human and Personnel safety.
- Equipment protection.
- Provides low impedance path for fault currents.
- To ensure good quality power.
- Protection against lightning and transient currents, noise reductions, Limitation of EMI.

### ***References:***

IEC 60364: Low Voltage Electrical Installations-Part 5-54: Selection & Erection of Electrical equipment- Earthing arrangement & protective conductors.  
 IEC 62561: Lightning Protection system Components.  
 IEC 62305: Protection Against Lightning –Part 3: Protection of structures & life Hazards  
 UL 467: Grounding and Bonding Equipments  
 UL96: Lightning Protection System – Components  
 IS 2309: Code of practice for protection of buildings & allied structures from lightning  
 IS 3043: Code of practice for earthing.

### ***Components of earthing system:***

- Earth electrode
- Couplers and Connectors
- Inspection Chamber (Earth Pit)
- Earth enhancement material
- Connecting cable/tape/strip with accessories.



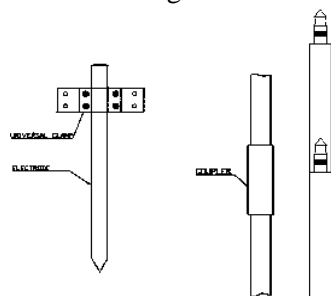
***Earth Electrode:***

Copper coated Solid steel Rods shall be made of high tensile low carbon steel rod, with molecular bonded with 99.9% electrolytic copper with minimum coating thickness of 250 microns. The minimum length of the earth rod shall be 3 meters which is either a single rod or smaller rods with couplers or similar arrangement. For dry areas, length of the rods can go up to 9 meters. The vendor should quote price of the rod in length of 3 meters. The rod as well as the couplers should satisfy the requirements as per the above-referred standards. For Lightning protection application rods should have a diameter of 14.2 mm or 17.2 mm. In order to carry fault current, earth rods used in Power networks should be of diameter 20 mm or 25 mm. In case of applications more than 3 meters, diameter of the rod should be 20 or 25 mm. These rods also should have facility to drive with an electric/hydraulic hammer.

Interconnecting Strips / Earthing Conductor: Copper coated steel strips / tapes should be used to interconnect different earthing rods as well as horizontal earthing (Ring earthing). These strips should have a coating thickness of minimum 70 microns and have minimum cross sectional area of 90 Sqmm. (Eg 30 X 3 strip)

***Couplers / Connecting clamps:***

Couplers for interconnecting rods should be made of Brass or any other copper alloy, which is resistant to corrosion. For rods with diameters larger than 20 mm self locking arrangements are preferable instead of couplers. Connectors for connecting Electrode with Earthing conductor/strip should be of Brass/copper alloy or copper coated steel. Fasteners should be made of Stainless steel. Size should be selected according to the electrode and earthing conductor dimensions. Different arrangements should be as per the below fig.

***Inspection Chamber :***

Should have an inner dimension of 250 mm X 250 mm X 250 mm made of FRP material. Flush Mounted, removable and lockable cover of the earth pit should be able to withstand 15KN. The area inside the inspection chamber should be such that, the UNIVERSAL CLAMP/EBB/Bus bar is not too deep inside the inspection chamber or projecting out of inspection chamber. The chamber should have facility for marking earth resistance and latest testing date by paint at the cover and previous recorded values inside the cover.

***Earth Enhancement material:***

This is a conductive compound producing low resistance of an earth termination system. Earth enhancing compound shall be so designed and constructed that in normal use their performance is

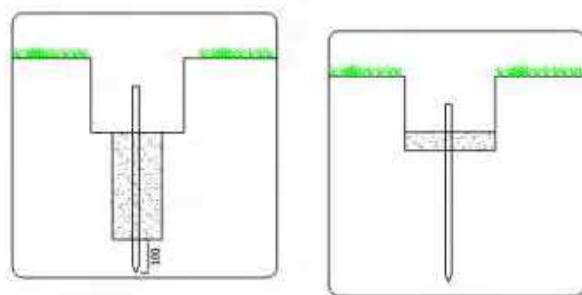
reliable and without danger to persons and the surroundings. The material shall be chemically inert to sub soil and shall not pollute the environment. It shall provide a stable environment in terms of physical and chemical properties and exhibit low resistivity. It shall not be corrosive to the earth electrode itself. The material should have a resistivity less than 50 Ohm meter

### ***Installation:***

Normal soil in Marsh land: Electrodes can be hand driven or hammered into earth for the required length.

Semi Hard Soil: Electrodes can be hammered electrically or hydraulically for the required length.

Hard Soil: Bore a hole with a minimum diameter of 100 MM with at a depth of up to 3 meters. Place the electrode at the centre of the hole in such a way that bottom 100 mm of the electrode is in bond with the mother soil. For deep driven rods with depth more than 3 meters, remaining length of the rod should be driven into the mother soil. (ref fig) Fill the hole with earth enhancement compound.



### ***Inspection & maintenance:***

Maintenance of the earthing system has to be done at least once in 6 months, preferably before the monsoon period and a record should be maintained to verify earthing system conductors and components, electrical continuity, earth resistance value, re-fastening of components viz-nuts, bolts etc.

### ***Drawing:***

Layout of the complete earthing system with dimensions shall be submitted.

Warranty: Earthing system should provide stable resistance for a period of 18 months after installation as well as for full season. During this period monthly readings are to be recorded by the end user.

### **Earth Enhancement Compound**

Earth enhancement material is a superior conductive material that improves earthing effectiveness, especially in areas of poor conductivity (rocky ground, areas of moisture variation, sandy soils etc.). It improves conductivity of the earth electrode and the ground contact area. It shall be tested and conform to the requirements of IEC 62561-7 having the following characteristics:-

- Shall be carbon based with min 95% of fixed carbon content premixed with corrosion resistant cement to have set properties. Cement shall not mix separately & shall not have Bentonite.
- Shall have high conductivity, improves earth's absorbing power and humidity retention capability.
- Shall be non-corrosive in nature having low water solubility but highly hygroscopic.
- Shall have resistivity of less than 0.12 ohms -meter.
- Shall be suitable for installation in dry form or in a slurry form.
- Shall not depend on the continuous presence of water to maintain its conductivity.
- Shall be permanent & maintenance free and in its "set form", maintains constant earth resistance with time.
- Shall be thermally stable between -100 C to +600 C ambient temperatures.
- Shall not dissolve, decompose or leach out with time.
- Shall not require periodic charging treatment nor replacement and maintenance.
- Shall be suitable for soils of different resistivity.
- Shall not pollute the soil or local water table and meets environmental friendly requirements for landfill, shall not be explosive & shall not cause burns, irritation to eye, skin etc. In this regard "Safety Data Sheets" shall be submitted by the manufacturers.

### **23.1 Earth Pit Cover**

- An Earth Inspection pit cover is an inspection chamber used to give safety to an earthing arrangement and also provide an easy access to earth resistance testing.
- Earth Pit cover shall be made of Poly Plastic material.
- Earth pit cover shall be tested at 5 ton load.

## **10 WIRING**

### **11.1 GENERAL**

Technical Specifications in this section cover the Internal Wiring Installations comprising of:

- Wiring for lights and convenience socket outlets etc. in concealed/surface conduit/raceways.
- Wiring for telephone outlets.
- Wiring for fire detection system
- Submain wiring.

### **11.2 STANDARDS AND CODES**

The following Indian Standard Specifications and Codes of Practice will apply to the equipment and the work covered by the scope of this contract. In addition the relevant clauses of the Indian Electricity Act 1910 and Indian Electricity Rules 1956 as amended upto date shall also apply. Wherever appropriate Indian Standards are not available, relevant British and/or IEC Standards shall be applicable.

BIS certified equipment shall be used as a part of the Contract in line with Government regulations. Necessary test certificates in support of the certification shall be submitted prior to supply of the equipment.

It is to be noted that updated and current Standards shall be applicable irrespective of those listed below.

660/1100 V grade PVC insulated wires.	IS 694 : 1990
Rigid steel conduits for electrical wiring.	IS 9537 : Part I 1980
	IS 9537 : Part II 1981
Accessories for rigid steel conduits	IS 3837 : 1990
Flexible steel conduits for electrical wiring	IS 3480 : 1990
Rigid PVC conduits	IS 9537 : Part-III
Switch socket outlets	IS 4615 : 1990
Switches for domestic and similar purposes	IS 3854 : 1997
Boxes for the enclosure of electrical accessories	IS 5133 : Parts I & II 1969
Code of practice for personal hazard	IS 1644: 1998
fire safety of buildings	
Code of practice for electrical installation	IS 1646 : 1997
fire safety of buildings	
Code of practice for electrical wiring installations	IS 732 : 1989

### **11.3 CONDUITS/ RACEWAYS**

#### **11.3.1 Steel Conduits**

These shall be of mild steel 16 gauge upto 32mm and 14 gauge for sizes above 32mm, electric resistance welded (ERW), electric threaded type having perfectly circular tubing. Conduits shall be precession welded ERW and shall be fabricated from tested steel strips of thickness as per ISS by high frequency induction weld process. Weld shall be smooth and of consistent of high quality to ensure crack proof bending. The conduits shall be black enamel painted inside and outside in its manufactured form. Wherever so specified, the conduit shall be galvanized. All conduits used in this work shall be ISI embossed.

#### **11.3.2 PVC Conduits**

Conduits shall be heavy gauge rigid PVC of minimum thickness of 2mm. Conduits shall be ISI marked confirming to IS : 9537 (Part-3)-1983. All conduit and conduit accessories shall be of PVC. Conduits shall be joined together by a vinyle type cement / solvents. Minimum size of conduit shall be 25mm. Conduit shall be fixed on ceiling or wall. All conduits shall be concealed

in wall ceiling etc. or fixed on surface of wall with clamps at regular interval as called for elsewhere. For termination of PVC conduits into switch outlet boxes, PVC female adapters shall be used. Wherever conduit run exceeds 10 metre, circular junction boxes shall be provided to facilitate pulling & inspection of wires. Inspection boxes shall be suitable located in co-ordination with the Engineer-in-charge. Conduits shall be bend using suitable size springs. Long radius bends shall be provided. Heating shall not be used to bend the conduits. Size of conduit shall depend upon number and size of wires to be drawn.

### **11.3.3 Steel Conduit Connections**

Connections between steel conduits shall be with screwed couplers of approved quality and finish, ensuring screwed metal to metal contact. Length of threads shall be as per ISS and sufficient to accommodate pipes to full threaded portion of couplers or accessories. Threads and sockets shall be free from grease and oil. Conduits shall be connected to outlet boxes by means of M.S. hexagon check-nuts fixed both inside and outside the box. Conduit edges shall be free of burrs and provided with screwed PVC bushes to avoid damage to insulation of conductors while pulling them through the conduits. Connections between M.S. and PVC conduits, if required, shall be through a junction box and never directly.

### **11.3.4 Bends**

Large right angle bends (more than 75 mm radius) or non right angle bends in conduit runs shall be made by means of conduits bending machines carefully so as not to cause any crack in the conduit. Small right angle bends in conduits runs can be made by standard conduit accessories (solid/inspection bends/elbows) no run of conduits shall have more than four right angle bends from outlet to outlet. Bends in multi runs of conduits shall be parallel to each other and neat in appearance, maintaining the same distance as between straight runs of conduits.

### **11.3.5 Conduit Accessories.**

#### **11.3.5.1 Standard accessories**

Heavy duty black enamel painted standard conduit fittings and accessories like standard/extra-deep circular boxes, looping in boxes, junction boxes, normal/ inspection bends, solid/inspection elbows, solid/inspection tees, couplers, nipples, saddles, check nuts, earth clips, ball socket joints etc. shall be of superior quality and of approved makes. Heavy duty covers screwed with approved quality screws shall be used. Superior quality screwed PVC bushes shall be used. Samples of all conduits fittings and accessories shall be got approved by Architect/Engineer/DFCCIL before use.

#### **11.3.5.2 Fabricated accessories**

Wherever required, outlet/junction boxes of required sizes shall be fabricated from 1.6 mm thick MS sheets excepting ceiling fan outlet boxes which shall be fabricated from minimum 2 mm thick sheets. The outlet boxes shall be of approved quality, finish and manufacture. Suitable means of fixing connectors etc., if required, shall be provided in the boxes. The boxes shall be

protected from rust by zinc phosphate primer process. Boxes shall be finished with minimum 2 coats of enamel paint of approved colour. A screwed brass stud shall be provided in all boxes as earthing terminal.

#### **11.3.5.2.1 Outlet Boxes For Light Fittings**

These shall be minimum 75mm x 75mm x 50mm deep and provided with required number of threaded collars for conduit entry. For ceiling mounted florescent fittings, the boxes shall be provided 300 mm off centre for a 1200 mm fitting and 150 mm off centre for a 600 mm fitting so that the wiring is taken directly to the down rod. 3mm thick Perspex / hylam sheet cover of matching colour shall be provided.

#### **11.3.5.2.2 Outlet Boxes For Ceiling**

Outlet boxes for ceiling fans shall be fabricated from minimum 2 mm thick MS sheet steel. The boxes shall be hexagonal in shape of minimum 100 mm depth and 60 mm sides. Each box shall be provided with a recessed fan hook in the form of one 'U' shaped 15 mm dia rod welded to the box and securely tied to the top reinforcement of the concrete slab for a length of minimum 150 mm on either side. 3 mm thick Perspex/hylam sheet cover of matching colour shall be provided.

#### **11.3.5.3 Boxes For Modular Wiring Accessories**

##### **11.3.5.3.1 Switch Boxes - Modular Type**

Switch boxes suitable to house modular type switches of required ratings, and fan regulators as required shall be provided. In case the number of switches in one box is not tallying with that available in standard manufacture, the box accommodating the next higher number of switches shall be provided without any extra cost. In case fan regulator/regulators is /are to be provided at a later dated, suitable provision for accommodating such regulators shall be made in the switch boxes and blank off covers shall be provided without any extra cost.

Switch boxes shall be so designed that accessories are mounted on a grid plate with tapped holes for brass machine screws leaving ample space at the back and on the sides for accommodating conductors, check-nuts and screwed bushes at conduit entries etc... The grid plates and M.S. boxes shall be fitted with a brass earth terminal. Boxes shall be attached to conduits by means of check-nuts on either sides of their walls. Moulded front covers made from high impact resistant, flame retardant and ultra violet stabilised engineering plastics shall be fixed by means of counter sunk chromium plated brass machine screws. No timber shall be used for any supports. Switch boxes shall be located with bottom at 1200 mm above floor level unless otherwise indicated.

##### **11.3.5.3.2 Modular Type Boxes For Socket/ Telephone/Call Bell Outlets**

Outlet boxes shall be suitable for housing modular type switched socket outlets/ telephone outlets/ buzzers and any other outlet as required. These shall be so designed that accessories are mounted on a grid plate with tapped holes for brass machine screws leaving ample space at the back and on the sides for accommodating conductors, checknuts and screwed bushes at conduit entries etc. The grid plates and M.S. boxes shall be fitted with a brass earth terminal. These shall be attached to conduits by means of check nuts on either sides of their walls. Moulded front

covers made from high impact resistant, flame retardant and ultra violet stabilized engineering plastics shall be used to mount the outlets and shall be fixed to the outlet M.S. boxes by means of counter sunk chromium plated brass machine screws. No timber supports shall be used. Boxes shall be located at skirting level or bottom at 1200 mm from floor or inside raceways on laboratory work tables., as indicated in drawings and/or as directed.

### 11.3.6 Cross Section

The conduits shall be of ample sectional area to facilitate simultaneous drawing of wires and permit future provision also. Total cross section of wires measured overall shall not normally be more than half the area of the conduit. Maximum number of PVC insulated 660/1100 Voltage grade copper conductor cable conforming to IS - 694 - 1990 as per table give below.

#### Maximum no of PVC insulated 660/1100 V grade aluminium/copper

#### Conductor cable conforming to IS : 694 - 1990

Normal Cross Sectional area of conductor in sq. mm	20 mm		25 mm		32 mm		38 mm		51 mm		64 mm	
	S	B	S	B	S	B	S	B	S	B	S	B
1	2	3	4	5	6	7	8	9	10	11	12	13
1.50	5	4	10	8	18	12	-	-	-	-	-	-
2.50	5	3	8	6	12	10	-	-	-	-	-	-
4	3	2	6	5	10	8	-	-	-	-	-	-
6	2	-	5	3	4	8	7	-	-	-	-	-
10	2	-	4	3	6	5	8	6	-	-	-	-
16	-	-	2	2	3	3	6	5	10	7	12	8
25					3	2	5	3	8	6	9	7
35							3	2	6	5	8	6
50									5	3	6	5
70									4	3	5	4

#### Note :

1. The above table shows the maximum capacity of conduits for a simultaneous drawing in of cables.
2. The columns headed 'S' apply to runs of conduits which have distance not exceeding 4.25 m between draw boxes and which do not deflect from the straight by an angle of more than 15 degrees. The

columns headed 'B' apply to runs of conduit which deflect from the straight by an angle of more than 15 degrees.

3. Conduits sizes are the nominal external diameters.

#### **11.4 WIRES**

Wiring shall be carried out with PVC insulated 660/1100 volt grade unsheathed single core wires with electrolytic annealed stranded copper (unless otherwise stated) conductors and conforming to IS 694/1990. All wire rolls shall be ISI marked. All wires shall bear manufacturer's label and shall be brought to site in new and original packages. Manufacturer's certificate, certifying that wires brought to site are of their manufacture shall be furnished as required.

#### **11.5 COAXIAL CABLES**

The coaxial cables shall be of wideband type with operation up to 300 MHz capability. Aging resistance shall comply with DIM 472.52 part 2 e.i. maximum 5% increase in attenuation at 200 MHz measured by artificial aging (14 days at 80°C) cables shall meet all exceed following specifications

Center core Dia	0.8 mm
Diaelectric Dia	4.8 mm
Dielectric	PE
Outer Conductor Dia	5.4 mm
Outer Dia	7.0 mm
Bending radius	more than 30 mm
Impedance	75 ohms
D.C Resistance	50 ohms/KM
Screening factor	more than 50
Attenuation	
50 Mhz	6.5
100 Mhz	9
200 Mhz	13
300 Mhz	16

#### **11.6 LAYING OF CONDUITS**



- Conduits shall be laid either recessed in walls and ceilings or on surface on walls and ceilings or partly recessed and partly on surface, as required.
- Same rate shall apply for recessed and surface conduiting in this contract.
- Stranded copper conductor insulated wire of size as per schedule of quantities shall be provided in entire conduiting for loop earthing.
- GI wire of suitable size to serve as a fish wire shall be left in all conduit runs to facilitate drawing of wires after completion of conduiting.

#### **11.6.1 Recessed Conduiting**

Conduits recessed in concrete members shall be laid before casting, in the upper portion of slabs or otherwise as may be instructed, so as to embedded the entire run of conduits and ceiling outlet boxes with a cover of minimum 12 mm concrete. Conduits shall be adequately tied to the reinforcement to prevent displacement during casting at intervals of maximum one metre. No reinforcement bars shall be cut to fix the conduits. Suitable flexible joints shall be provided at all locations where conduits cross expansion joints in the building.

Conduits recessed in brick work shall be laid in chases to be cut by electrical Contractor in brick work before plastering. The chases shall be cut by a chase cutting electric machine. The chases shall be of sufficient width to accommodate the required number of conduits and of sufficient depth to permit full thickness of plaster over conduits. The conduits shall be secured in the chase by means of heavy duty pressed steel clamps screwed to MS flat strip saddles at intervals of maximum one metre. The chases shall then be filled with cement and coarse sand mortar (1:3) and properly cured by watering.

Entire recessed conduit work in concrete members and in brick work shall be carried out in close coordination with progress of civil works. Conduits in concrete members shall be laid before casting and conduits in brick work shall be laid before plastering. Should it become necessary to embedded conduits in already cast concrete members, suitable chase shall be cut in concrete for the purpose. For minimizing this cutting, conduits of lesser diameter than 25 mm and outlet boxes of lesser depth than 50 mm could be used by the Contractor for such extensions only after obtaining specific approval from Architects/Owners. For embedding conduits in finished and plastered brick work, the chase would have to be made in the finished brick work. After fixing conduit in chases, chases shall be made good in most workmanlike manner to match with the original finish.

Cutting chases in finished concrete or finished plastered brick work for recessing conduits and outlet boxes etc shall be done by the Contractors without any extra cost.

#### **11.6.2 Surface Conduiting**

Wherever so desired, conduit shall be laid in surface over finished concrete and/or plastered brickwork. Suitable spacer saddles of approved make and finish shall be fixed to the finished structural surface along the conduit route at intervals not exceeding 600 mm. Holes in concrete or brick work for fixing the saddles shall be made neatly by electric drills using masonry drill bits. Conduits shall be fixed on the saddles by means of good quality heavy duty MS clamps screwed

to the saddles by counter sunk screws. Neat appearance and good workmanship of surface conduiting work is of particular importance. The entire conduit work shall be in absolute line and plumb.

#### **11.6.3 Fixing of conduit fittings and accessories**

For concealed conduiting work, the fittings and accessories shall be completely embedded in walls/ceilings leaving top surface flush with finished wall/ceiling surface in a workman like manner.

Loop earthing wire shall be connected to a screwed earthstead inside outlet boxes to make an effective contact with the metal body.

#### **11.6.4 Painting and Colour coding of conduits**

Before laying, conduits shall be painted specially at such places where paint has been damaged due to vice or wrench grip or any other reason.

If so specified, surface conduits shall be provided with 20 mm wide and 100 mm long colour coding strips as below

<b>Use</b>	<b>Code colour</b>
Low Voltage	Grey
Fire alarm	Red
Telephone	Black
PA system	Brown
Earthing system	Green
Control system lighting	Purple

#### **11.6.5 Protection of Conduits**

To safeguard against filling up with mortar/plaster etc. all the outlet and switch boxes shall be provided with temporary covers and plugs which shall be replaced by sheet/plate covers as required. All screwed and socketed joints shall be made fully water tight with white lead paste.

#### **11.6.6 Cleaning of Conduit Runs**

The entire conduit system including outlets and boxes shall be thoroughly cleaned after completion of erection and before drawing in of cables.

#### **11.6.7 Protection Against Dampness**

All outlets in conduit system shall be properly drain and ventilated to minimize chances of condensation/sweating.

#### **11.6.8 Expansion Joints**

When crossing through expansion joints in buildings, the conduit sections across the joint shall be through approved quality heavy duty metal flexible conduits of the same size as the rigid conduit.

#### **11.6.9 Loop Earthing**

Loop earthing shall be provided by means of insulated stranded copper conductor wires of sizes as per Schedule of Quantity laid alongwith wiring inside conduits for all wiring outlets and sub-mains. Earthing terminals shall be provided inside all switch boxes, outlet boxes and draw boxes etc.

### **12.7 LAYING AND DRAWING OF WIRES**

#### **12.7.1 Bunching of Wires**

Wires carrying current shall be so bunched in conduits that the outgoing and return wires are drawn into the same conduit. Wires originating from two different phases shall not be run in the same conduit.

#### **12.7.2 Drawing of Wires**

The drawing of wires shall be done with due regard to the following precautions:-

- No wire shall be drawn into any conduit, until all work of any nature, that may cause injury to wire is completed. Burrs in cut conduits shall be smoothen before erection of conduits. Care shall be taken in pulling the wires so that no damage occurs to the insulation of the wire. Approved type bushes shall be provided at conduit terminations.
- Before the wires are drawn into the conduits, conduits shall be thoroughly cleaned of moisture, dust, dirt or any other obstruction by forcing compressed air through the conduits if necessary..
- While drawing insulated wires into the conduits, care shall be taken to avoid scratches and kinks which cause breakage of conductors.
- There shall be no sharp bends.
- The Contractor shall, after wiring is completed, provide a blank metal/sunmica plate on all switch / outlet / junction boxes for security and to ensure that wires are not stolen till switches / outlets etc.. are fixed at no extra cost the contractor shall be responsible to ensure that wires and loop earthing conductors are not broken and stolen. In the event of the wire been partly / fully stolen , the contractor shall replace the entire wiring alongwith loop earthing at no extra cost to the Owners. No joint of any nature whatsoever shall be permitted in wiring and loop earthing .

### **12.7.3 Termination /Jointing of Wires**

- Sub-circuit wiring shall be carried out in looping system. Joints shall be made only at distribution board terminals, switches/buzzers and at ceiling roses/connectors/lamp holders terminals for lights/fans/socket outlets. No joints shall be made inside conduits or junction/draw/inspection boxes.
- Switches controlling lights, fans or socket outlets shall be connected in the phase wire of the final sub circuit only. Switches shall never be connected in the neutral wire.
- Wiring conductors shall be continuous from outlet to outlet. Joints where unavoidable, due to any special reason shall be made by approved connectors. Specific prior permission from Architect/Engineer/DFCCIL in writing shall be obtained before making such joint.
- Insulation shall be shaved off for a length of 15 mm at the end of wire like sharpening of a pencil and it shall not be removed by cutting it square or wringing.
- Strands of wires shall not be cut for connecting terminals. All strands of wires shall be twisted round at the end before connection..
- Conductors having nominal cross sectional area exceeding 4 sq. mm shall always be provided with crimping sockets.
- At all bolted terminals, brass flat washer of large area and approved steel spring washers shall be used.
- Brass nuts and bolts shall be used for all connections.
- The pressure applied to tighten terminal screws shall be just adequate, neither too much nor too less.
- Switches controlling lights, fans, socket outlets etc. shall be connected to the phase wire of circuits only.
- Only certified valid license holder wiremen shall be employed to do wiring / jointing work.

### **12.7.4 Load Balancing**

Balancing of circuits in three phase installation shall be planned before the commencement of wiring and shall be strictly adhered to.

### **12.7.5 Colour Code of Conductors**

Colour code shall be maintained for the entire wiring installation - red, yellow, blue for three phases, black for neutral and green for earth.

## **12.8 MEASUREMENT AND PAYMENT OF WIRING**

Wiring for lights, fans, convenience socket outlets etc. shall be measured and paid for on POINT BASIS as itemized schedule of quantities and as elaborated as below unless otherwise stated.

## **12.9 Wiring**

All the wiring installation shall be as per IS: 694/IS:732 with latest amendment. FRLS PVC insulated copper conductor cables as specified in bill of quantities shall be used for sub-circuit runs from the distribution boards to the points and shall be pulled into conduits. They shall be twisted copper conductors with thermoplastic insulations of 660/1100 volts grade. Colour Code for wiring shall be followed.

Looping system of wiring shall be used, wires shall not be jointed. Where joints are unavoidable, they shall be made through approved mechanical connectors with prior permission of the consultant. No reduction of strands are permitted at terminations. No wire smaller than 2.5 sq.mm shall be used or as per B.O.Q. Wherever wiring is run through trunkings or raceways, the wires emerging from individual distributions shall be bunched together with cable straps at required regular intervals. Identification ferrules indicating the circuit and DB number shall be used for submains, sub-circuit wiring. The ferrules shall be provided at both ends of each submain and sub-circuit.

Where single phase circuits are supplied from a three phase and a neutral distribution board, no conduit shall contain the wiring fed from more than one phase. In any one room in the premises where all or part of the electrical load consists of lights, fans and/or other single phase current consuming devices, all shall be connected to the same phase of the supply. Circuits fed from distinct sources of supply or from different distribution boards or through switches or MCBs shall not be bunched in one conduit. In large areas and other situations where the load is divided between two or three phase, no two single phase switches connected to different phase shall be mounted within two meters of each other.

All splicing shall be done by means of terminal blocks or connectors and no twisting connection between conductors shall be allowed.

Metal clad sockets shall be of die-cast non-corroding zinc alloy and deeply recessed contact tubes. Visible scraping type earth terminal shall be provided. Socket shall have push on protective cap. Socket shall have MCB/ELCB/RCCB as specified in the schedule of work.

## **13. Luminaires/Fans**

### **13.1 Ceiling Fans**

Ceiling fans shall conform to IS:374 (latest edition) all respects and shall be smooth and silent in operation. The ceiling fan shall be BLDC type with energy efficiency. The blades shall be made of aluminium sheets painted in white shade. The design and construction of blades shall be such that maximum quantity of air is displaced in smooth manner. The motor and blades shall be statically and dynamically balanced. The fans shall be provided with ball bearing only. The ceiling fan shall be provided with rubber shackle and a down rod shall be as per requirements. The suspension arrangement shall be jointed to the fan motor by means of a thread joint and a safety locking arrangement. Fans shall be provided with bottom cover and top canopy. Electronic stepless regulators shall be provided, with every fan. Ceiling fans shall be suspended from the special hooks or special fan hook boxes. Where hooks are used the wiring to the fan shall be

from a ceiling rose. Wherever special fan hook boxes are used, the fan wiring shall be terminated in porcelain/PVC three way connector. Lead-in-wires shall have cross-section area of not less than 23/.0076 (copper).

### **13.2 Exhaust Fan**

Propeller type exhaust fan shall conform to IS:2312 (latest edition) in all respects. The motor shall be of die-cast aluminium case. The fan motor shall be of squirrel cage induction type single phase motors shall be capacitor start and run type.

Exhaust fans be provided with a special anticorrosive treatment to withstand normal concentrations of chemical fumes in the environment.

The fan shall be designed to withstand the effects of moisture under normal conditions of use. The design of motor and its windings shall be such that moisture in surrounding is not absorbed by the windings. Exhaust fans shall be complete with mounting rings, ring arms and a resilient suspension. The motor and blades shall be of mild steel and so designed that they operate smoothly with minimum noise. The fans shall be finished to be a glossy grey shade with an approved enamel paint. The fans shall also be provided with gravity louvers for exhaust arrangement or bird screen for inlet arrangement.

Exhaust fans shall be fixed at the locations shown on the drawings. The fans shall be fixed by means of rag bolts grouted in wall. Exhaust fan be connected to the exhaust fan point by means of a 3 core flexible cord.

## **14. CABLE TRAYS**

Cable trays, of sizes as per schedule of quantities and drawings shall be of perforated doubled bend channel/ladder design unless otherwise stated. Cable trays shall be fabricated from minimum 2 mm thick sheet steel and shall be complete with tees, elbows, risers, and all necessary hardware. Cable trays shall comply with the following:

Trays shall have suitable strength and rigidity to provide proper support for all contained cables. Trays shall not have sharp edges, burrs or projections injurious to cable insulation. Trays shall include fittings for changes in direction and elevation. Cable trays and accessories shall be painted with one shop coated of red oxide zinc chromate primer and two side coats of aluminium alkyd paint or approved equivalent. Cable trays shall not have sharp edges, burrs or projection that may damage the insulation jackets of the wiring. Cable trays shall have side rails or equivalent structural members.

Unless otherwise specifically noted on the relevant layout drawing, all cable tray mounting works to be carried out ensuring the following :

Cable tray mounting arrangement type to be as marked on layout drawing. Assembly of tray mounting structure shall be supplied fabricated, erected & painted by the electrical contractor. Tray mounting structures shall be welded to plate inserts or to structural beams as approved by the Owners/Architects. Wherever embedded plates & structural beams are not available for welding the tray mounting structure electrical contractor to supply the MS plates & fix them to floor slab by four anchor fasteners of minimum 16 mm dia having minimum holding power of 5000 Kg at no extra cost. Maximum loading on a horizontal support arm to be 120 Kg. metre of

cable run. Width of the horizontal arms of the tray supporting structures to be same as the tray widths specified in tray layout drawings, plus length required, for welding to the vertical supports. The length of vertical supporting members for horizontal tray runs shall be to suit the number of tray tiers shown in tray layout drawings. Spacing between horizontal supports arms of vertical tray runs to be 300 mm. Cable trays will be welded to their mounting supports. Minimum clearance between the top most tray tier and structural member to be 300 mm. Cables in vertical race ways to be clamped by saddle type clamps to the horizontal slotted angels. Clamps to be fabricated from 3 mm thick aluminium strip at site by the electrical contractor to suit cable groups. The structural steel (standard quality) shall be according to latest revision of IS : 226 & 808. Welding shall be as per latest revisions of IS : 816. All structural steel to be painted with one shop coat of red oxide and oil primer followed by a finishing coat of aluminium alkylid paint where any cuts or holes are made on finished steel work these shall be sealed against oxidation by red oxide followed by the same finishing paint. Steel sheet covers wherever indicated to be similarly painted. Trays shall be erected properly to present a neat and clean appearance. Trays shall be installed as a complete system. Trays shall be supported adequately by means of painted MS structural members secured to the structure by dash fasteners or by grouting. The entire cable tray system shall be rigid. Each run of cable tray shall be completed before laying of cables. Cable trays shall be erected so as to be exposed and accessible.

## **15 TECHNICAL SPECIFICATIONS FOR MACHINE-ROOM LESS LIFTS**

### **15.1 SCOPE**

This specification covers the requirements of Design, Fabrication, Supply, Installation, Commissioning, packing, forwarding, transportation to site, unloading, furnishing of final drawings and manuals, handling at site, performance demonstration and performance acceptance etc. of various capacity passenger and goods lifts as per BOQ. To make the system complete in all respects and required Civil/Electrical work as per technical Specification & as per the tender document. The lift shall be capable for seamless integration with BMS.

### **15.2 SITE CONDITIONS**

Temperature	:	Maximum 45 Deg. C Minimum 4 Deg. C
Humidity	:	Not more than 90% at maximum temperature.
Rainfall	:	1000 - 1500mm Per Annum

+

### **15.3 ELECTRICAL SUPPLY SPECIFICATION**

System Voltage	415V
Voltage variation limits	+/- 10%
No. of phases	3
Frequency	50 c/s
Frequency variation limits	+3% or -5%

Fault level	Not exceeding 50 KA at 415 V
Neutral earthing on LV side	Solidly earthed

## 15.4 STANDARDS

The following Indian Standard Specifications and Codes of Practice, currently applicable and updated as of date irrespective of dates given below, shall apply to the equipments and the work covered by this contract. In addition the relevant clauses of the Indian Electricity Act 2003 and Indian Electricity Rules 1956 with latest amendments up to date shall also apply. Wherever appropriate Indian Standards are not available, relevant British and/or IEC Standards shall be applicable

1. Code of Practice for installation, operation and maintenance of electric passenger & goods lifts.IS-14665 (Part 2) Sec-1 :2000
2. Code of practice for installation, operation and maintenance of electric service lift.IS-14665 (Part 2) Sec-2 : 2000
3. Safety Rules Section-1 Passenger and Good lifts IS-14665 (Part 3) Sec-1 :2000
4. Safety Rules Section-2 – Service Lifts IS-14665 (Part 3) Sec-2 : 2000
5. Outline dimension for electric lifts. IS-14665 (Part-1) : 2000
6. Inspection Manual for Electric Lifts IS-14665 (Part 5) : 1999
7. Electric Traction Lifts – Components
8. Installation And Maintenance of Lifts For Handicapped Persons (Code of Practice) IS-14665 (Part 4) Sec-1 to 9 :2001IS 15330 :2003
9. Specification for lifts cables. IS-4289 (Par-1) : 1984 Reaffirmed 1991
10. Specification for hot rolled and slit steel tee bars IS-1173-1978 Reaffirmed 1987
11. Method of loading rating of worm gear. IS-7443-1974 Reaffirmed 1991
12. Code of practice for selection of standard worn and helical gear box.IS-7403-1974 Reaffirmed 1991
13. Isometrics screw threads. IS-4218-(Part-II)1976 Reaffirmed 1996
14. Degree of protection provided by enclosure for low voltage switchgear and control gear. IS-2147-1962
15. Classification of insulating materials for electrical machinery and apparatus in relation to their thermal stability in service. IS-1271- 1985 Reaffirmed 1990
16. Code of practice for earthing. IS-3043-1987
17. Electrical installation Fire Safety of Building. IS-1646-1997
18. PVC insulated electric cable for working voltage up to and including 1100 volts.IS-694-1990
19. Code of practice for electrical wiring and installation IS-732-1989
20. PVC insulated (Heavy Duty) electric cables for working voltage up to and including 1100 volts. IS-1554-1988 (Part-1)
21. Flexible steel conduits IS-3480-1966
22. Accessories for rigid steel conduit for electrical wiring IS-3837-1976
23. Boxes for the enclosure of electrical accessories IS-5133-1969 (Part 1)
24. Guide for safety procedures and practices in electrical work. IS-5216- 1982 (Part-1)
25. Conductors for insulated electric cables and flexible cordes IS-8130- 1984



26. Miniature Circuit Breakers IS-8828-1996
27. Rigid steel conduits for electrical wiring (Second revisions) IS-9537-1981
28. Methods of test for cables IS-10810-1998
29. Earth Leakage Circuit Breakers. IS-12640-1988
30. Moulded Case Circuit Breakers IS-13947-1993
31. General requirement for switchgear and control gear for voltage not exceeding 1000 volts.IS-13947-1993
32. 1100 volt grade XLPE insulated armoured cables IS 7098
33. Specifications for hoistway door-locks IS 7754-1975
34. Rules for design, installation, testing and operation of lifts, escalators and moving parts.IS 1735-1975

In addition the relevant clauses of the following, as amended upto date shall ALSO apply:

- Fire safety regulations pertaining to lifts

The tenderers shall also take into account local and State regulations as in vogue for the design and installation of lifts.

## **15.5 GENERAL REQUIREMENTS**

Machine room-less electric traction passenger elevators work includes:

1. Gearless electric traction passenger elevators.
2. Elevator car enclosures, hoistway entrances and signal equipment.
3. Operation and control systems.
4. Accessibility provisions for physically disabled persons.
5. Equipment, machines, controls, systems and devices as required for safely operating the specified elevators at their rated speed and capacity.
6. Materials and accessories as required to complete the elevator installation.

The Elevators shall include all elements confirming to specifications or as amended herein. Elevators covered by these specifications shall be provided, installed, tested, commissioned, certified and approved as per statutory requirements of Lift Inspectorate. Elevator shall have its own driving machine.

The method of drive shall be Electric Traction with Gear less motor having VVVF Control.

The design of the Elevators shall take into consideration fire prevention, elimination of dust and dirt traps, and easy accessibility for cleaning and routine maintenance.

## **15.6 ELECTRIC TRACTION DRIVE SYSTEM**

### **15.6.1 TRACTION MACHINE**

The construction of all Elevator machines shall conform with IS-14665

#### **15.6.1 BRAKE**

- a. The Electro-magnetic brake with non-asbestos lining shall be spring applied and electrically released type having noiseless operation.

- b. The brake shall be capable of stopping and holding the Elevator car in its downward travel to rest with 125% of its rated load from the maximum governor tripping speed. In this condition the retardation of the Car shall not exceed that resulting from the operation of the Safety gear or stopping on the buffer.
- c. Springs used to apply the brake shoes (two nos.) shall be in compression and adequately supported.
- d. Brake linings shall be of renewable incombustible materials and shall be secured to the brake shoes such that normal wear shall not weaken their fixings. Band brakes shall not be used.
- e. No earth fault, short circuit or residual magnetism shall prevent the brake from being applied in the event of loss of power supply to the Elevator motor and control circuit.
- f. A means of adjusting the brake plunger stroke and releasing the brake in emergency shall be provided.
- g. The Elevator machine shall be fitted with a manual emergency device capable of having the brake released by hand and requiring a constant effort to keep the brake open.
- h. The fail safe break shall incorporate an approved design of brake switch i.e. pick up, hold, discharge. Brake coil shall be wired in series & their respective switches in parallel. The operation of brake shall be thyristor controlled from solid state drive in order to effect minimum pick up time and synchronized start.

### **15.6.2 Driving Mechanism**

#### **Lift Machine**

The lift machine shall be suitable for 415 volt 3 phase 50 Hz AC supply with a voltage variation of  $\pm 10\%$ . The lift machine shall have high efficiency and low power consumption and shall be designed to withstand peak currents in lift duties.

### **15.6.3 Driving Sheaves**

- a. The sheaves shall be manufactured in steel or SG iron and fitted with sealed for life lubricated bearings.
- b. The sheaves shall have machined rope grooves that can be reworked for future wear.
- c. Adequate provision shall be made to prevent any suspension ropes leaving groove due to rope slack or introduction of foreign objects.

### **15.6.4 Alignment**

- a. The brake plunger, collar, sleeve, motor, sheaves and all bearings shall be mounted and assembled so that proper alignment of these parts is maintained.
- b. The assembly shall be reviewed and rectified when excessive noise is emitted during operation.

### **15.6.5 Gearless Machines**

The gearless machine shall consist of a motor traction sheave and brake drum or brake disc completely aligned on a single shaft. Gearless machine shall be AC gearless with VVVF drive.

### **15.6.6 Anti-Vibration Supports**

The whole traction machine shall be mounted on appropriate anti-vibration supports to minimize noise and vibration.

## **15.7 CONTROL SYSTEMS**

### **15.7.1 DESCRIPTION**

The Lifts shall have state of art microprocessor based AC variable voltage variable frequency (ACVVVF) drive. Some of the technical parameters required are innumerate below.

- a. Starting current 1.2 - 1.5 times full load running current
- b. Power saving 50 - 55%
- c. Leveling accuracy  $\pm 3$  mm
- d. Acceptable voltage fluctuation +10%

The controller shall be suitable mounted totally enclosed cubicle type with hinged doors on the front provide easy access to all components in the controller. Cubicle shall be well ventilated such that the temperature inside never exceeds the safe limits of the components at ambient room conditions. The controller shall operate within the supply voltage variation of plus 10% to minus 10% of the nominal voltage.

The Controller shall include protection against the following abnormalities and shall cut off the power supply, apply the brake and bring the car to a rest in the event of any of the abnormalities occurring.

- a. Over current
- b. Under voltage
- c. Overvoltage
- d. Single phasing
- e. Phase reversal
- f. Earth leakage

### **15.7.2 Features**

Control system features are detailed as below.

- **Attendant Operation**

Lift shall be provided with attendant control facilities. A key switch for change of operation mode shall be provided in a lockable recess panel on the car operation panel. After gaining control on the lift, the attendant can direct the car to stop at any storey. The attendant can also by pass the landing calls (but not cancel them) or reverse the direction of travelling.

- **Automatic By-pass**

Load weighing devices located either on car top or under the car cage shall be provided for all lifts. Whenever the load exceed 60-70% of the capacity load of the lifts, the lifts shall ignore all landing calls and only respond to car calls.

- **Over load device**

A load weighing devices shall operate when the load in the car exceeds the rated capacity. The operation of the device shall activate buzzer sound and flashing 'overload' signals. At the same time the car doors shall be prevented from closing. When the excess load has been removed from the car, the buzzer alarm shall be muted automatically and the car shall function normally. The sensitivity shall be 30 kg for Passenger lift.

- **Automatic self-levelling**

All lifts shall be provided with automatic self-levelling feature that shall bring the lift car level to within  $\pm 3$  mm for passenger elevators of the landing floor regardless of load or direction of travel. The automatic self levelling feature shall correct for over travel and rope stretch.

## **15.8 LIFT CAR, DOORS AND SAFETY DEVICES**

### **15.8.1 CAR ENCLOSURES**

- **Frame**

Every lift car body shall be in a steel car frame assembly which shall have sufficient mechanical strength to resist the forces applied by the safety gear or impact of the car on the buffers. The deflection of the steel members carrying the platform shall not exceed 1/1000 of their span under static conditions when the rated load is evenly distributed on the platform.

At least four renewable guide shoes or shoes with renewable linings or sets of guides rollers shall be provided two at the top and two at the top and two at the bottom of the car frame assembly.

- **Enclosure finishes**

The car enclosure, doors etc. shall be as per detailed in BOQ. The following are to be provided.

- Alarm System: An emergency alarm buzzer, including wiring shall be provided and connected to a plainly marked push button in the car operating panel. The alarm bell shall be located in central security room. The alarm unit shall be solid state siren type, to give a waxing and waning siren when the alarm button in the car is pressed momentarily
- Sealed Maintenance Free Nickel Cadmium Batteries capable of maintaining the following in each lift for 2 hrs after mains failure.
  - Emergency light of adequate illumination in car
  - Car Ventilation
  - ARD
  - Intercommunication System
  - Alarm bell

- One no. 16 amp switch socket outlet to IP 54 and a permanent weatherproof type luminaries to IP54 (with lighting switch ) adequately protected shall be provided on the top of the lift car for maintenance
- One no. 16 amp switch socket outlet to IP 54 at bottom of lift car for maintenance

### **15.8.2 OPERATION PANEL**

A full length car operating panel incorporating following control/indications shall be provided on the return panel

- CD Illuminated touch push buttons of micro pressure type corresponding to the floors served at Ground floor and Inside Car. For Other floors LED Illuminated touch push buttons of micro pressure type to be provided.
- Door open and door close button
- Emergency stop button with Alarm
- Two position key operated switch for 'with attendant' and 'without attendant' operation.
- Ventilation fan ON/OFF switch with auto OFF when there is no call after 120 seconds (Two Speed & concealed vents).
- Built in intercom of the hands free type as well as space for providing EPABX telephone instrument and 5 pair telephone trailing cable to communicate from car to Two Locations i.e. Operator's Room (at remote location) & Security Guard Room and vice-versa.
- Dynamic car direction display
- Car position indicator (digital)
- Audio/Visual overload warning indicator
- Digital voice synthesizer (Optional) for announcing special messages with background music.

### **15.8.3 LANDING FIXTURE**

The landing fixtures shall be recess mounted on a base junction box in the wall by the side or on top of landing doors as required. Each landing fixtures shall consist of micro touch type landing call buttons with illuminated call acknowledge signal and illuminated digital type car position indicators on separate stainless steel face panels with hairline finish.

### **15.8.4 CAR AND LANDING DOORS**

All car doors shall extend to the full height and width of landing opening unless otherwise specified and shall be operated with variable frequency door operator. A similar imperforate door shall be provided for every landing opening in the lift hoistway enclosure. The top track of the landing and car doors shall not obstruct the entrance to the lift cars. All car and landing doors shall have a fire resistance of not less than 1 hours. In addition, all the car and landing doors shall meet the following general requirements.

○ **Car door locking devices**

Every car door shall be provided with an electrical switch to prevent the lift car from being started or kept in motion unless the car door is closed. A mechanical locking device shall also be provided to prevent door opening from inside the car whilst the car is in motion.

○ **Landing door locking devices**

Every landing door shall be provided with a mechanical locking device to prevent opening of the door from the landing side in normal cases unless the lift car is in that particular landing zone.

○ **Projections and recesses**

Sliding car and landing doors shall be guided on door tracks and sills for the full travel of the doors.

○ **Door locking devices**

All doors locking devices, door switches and associated actuating rods, levers or contracts, shall be inaccessible from the landing or the car.

○ **Protective devices**

Protective devices shall be fitted to the leading edges of both car door panels. It shall automatically initiate reopening of the door in the event of a passenger being struck (or about to be struck) by the door in crossing the entrance during the closing movement. The obstruction of either leading edge when closing shall actuate the protective device to function.

○ **“Door open” alarm**

“Door open” alarm shall be provided in the car to initiate alarm and a continuous buzzer if a car or landing door has been mechanically kept open for a present period. The period shall be adjustable from 0-10 minute.

○ **Emergency landing door unlocking devices and key**

- Every landing door shall be provided with an emergency landing door unlocking device. When operated by an authorized person with the aid of a key to fit the unlocking triangle, the landing door shall be unlocked irrespective of the position of the lift car for rescue purpose. When there is no “unlocking” action, the key shall only be able to stay in the locked position.
- In the case of coupled car and landing doors, the landing doors shall be automatically closed by means of weight or springs when the car is outside the unlocking zone.

### 15.8.5 Door Hangers and Tracks

The car and the landing doors shall be provided with two point suspension sheave type hangers complete with tracks. Sheaves and rollers shall be steel with moulded nylon collar and shall include shielded ball bearings. Tracks shall be of suitable steel section with smooth surface. The landing doors shall be complete with headers, sills, frames etc. as required.

#### **15.8.6 Lift Door Protection**

Multiple-Infra red door protection and mechanical shoes shall be provided for lift to control door movement which shall cover the entire door opening effectively.

#### **15.8.7 Protective Hand Rail in the Car**

#### **15.8.8 CABIN FAN**

A noiseless pressure fan shall be provided in the lift cabin.

### **15.9 HOIST ROPES**

Hoist way material shall be non-flammable (02 hrs fire rated) except travelling cables which shall be flame resistant.

#### **Lift Ropes – IS 14665 (Part 4 / Sec 8)-2001**

Round strand steel wires ropes made from steel wire ropes having a tensile strength not less than 12.5 tonnes/cm<sup>2</sup> and of good flexibility shall be used for lift. Lubrications between the strands shall be achieved by providing impregnated hemp core. The lift ropes shall conform to IS 14665-(Part-4-Sec. 8):2001 and the required factor of safety shall be adhered to. The minimum diameter of rope for cars and counter weight of passenger and goods lift shall be 8mm.

#### **Rope fastenings**

The ends of lift ropes shall be properly secured to the car and counter weight hitch plates as the case may be with adjustable rope shackles having individual tapers babbitt sockets, or any other suitable arrangement. Each lift rope shackle shall be fitted with a suitable shackle spring, seat washer, shackle nut & lock & shackle nut split pin.

#### **Guards for Lift Ropes**

Where lift ropes run round a sheave or sheaves on the car and/ or counterweight of geared/ gearless machine suitable guards shall be provided to prevent injury to maintenance personnel.

#### **Number & Size of Ropes**

The contractor must indicate the number and size of lift ropes and governor ropes proposed to be used, their origin, type, ultimate strength and factor of safety. The contractor should furnish certificate or ropes from the rope manufacturers issued by competent authority.

#### **15.10 COUNTER WEIGHT**

The counter weight for lift cars shall be in accordance with clause 6 of IS 14665 (Part 4-Sec-3) : 2001 and shall be designed to balance the weight of empty lift car plus approximately 50 percent of the rated load. It shall consist of cast sections firmly secured in relative movement by at least two numbers steel tie rods having lock nuts/split pins at each end and passing through each section and Housed in a rigid steel frame work. Cracked and broken sub weights shall not be accepted. Counter weight for passenger lifts should be able to accommodate suitable weight Interior finishes. In case interior finishes material exceeds this provision, then the elevator contractor shall adjust the Counter Weight accordingly, however this will be decided and intimated much before the delivery of the elevators.

- **Counter Weight Guards**

Guards of wire metal / mesh shall be provided in the lift pit to a suitable height above the pit floor to eliminate the possibility of injuries to the maintenance personnel.

#### **15.11 GUIDES / Guide Rails**

Car and counterweight guide shall be machined T section as per relevant Indian Standards IS-14665 of 2000 revised up to date. The guides shall be capable of withstanding forces resulting from the application of the car or counter weight safety devices The guide rails shall be minimum 16mm Tongued & Grooved type.

#### **15.12 TRAILING CABLES**

A single trailing cable for lighting control and signal circuit is permitted, if all the conductors of this trailing cables are insulated for maximum voltage running through any one conductor of this cable. The lengths of the cables shall be adequate to prevent any strain due to movement of the car. All cables shall be properly tagged by metallic / plastic tags for identification. Cable jacket should be suitable for immersion in water, salt water & oil etc.

#### **15.13 SAFETY DEVICES**

Safety devices shall be capable of operating only in the downward direction and stopping fully loaded car, at the tripping speed of the over speed governor, even if the suspension devices break, by gripping the guides, and holding the car there. Governor sheeve in elevator pit shall be enclosed in a wire cage to a height of 2.40 mtr. All safety devices statutorily required by Lift Inspector, including but not restricted to the following shall be provided.

- **Terminal slow down switches**



These shall be provided and installed to slow down the lift car when approaching the top and bottom landings. The slow down switches shall act independently from the normal car operating device.

- **Over travel limit switches**

These shall be provided and installed to stop the car within the top and bottom clearance, independent of the normal car operating device. The bottom over travel limit switch shall become operative when the bottom of the car touches the buffer.

When the over travel limit switches are operative, it shall be impossible to operate the car until the car has been hand would to a position within the normal travel limits.

- **Pit Switch**

An emergency stop switch shall be located in the pit which when operated shall stop the car regardless of the position of hoist way.

- **Terminal Buffers**

Suitable spring buffers mounted on RCC foundation blocks shall be provided in the pit in compliance with ANSI/ASME/CENEN-81 /JIS codes for stopping the car in case of mal-operation. Dowels for the purpose shall be left while casting the pit floor alternatively floor reinforcement could be exposed by chipping for welding additional reinforcement for Dowels. However clearance from underside of the car resting on a fully compressed buffer shall not be less than 1.20 mtr. Buffers shall be designed for a design speed + 15%. Oil buffers shall be provided for the passenger elevators for speed of more than 1.75 mps and spring buffers for lower speed.

- **Interlocking**

Adequate interlocking is to be provided so that the car shall not move if the landing doors are even partially open and also the lift is overloaded.

- **Over speed governor**

Over speed governor shall be of centrifugal type and shall operate the safety gear at a speed at least equal to 115% of the rate speed and less than the over speed governors shall be driven by flexible wire ropes with the following requirements:

- The breaking load of ropes shall be related to the force required to operate the safety gear by the safety factor of at least 8
- The nominal rope diameter shall be at least 7 mm
- The ratio between the pitch diameter of the over speed governor pulley and the

nominal rope diameter shall be at least 30 The over speed governors shall be sealed after setting the tripping speed. The breaking or slackening of the governor rope shall cause the motor to stop by an electric safety device.

- **Alarm bells**

A Concealed 200 mm diameter alarm bell shall be installed in the main security area. The alarm bell shall sound when the alarm bell button in the car operating panel is pressed. The bell shall mute when the pressure on the alarm bell button is released.

- **Emergency Stop Switches**

An emergency stop for use by maintenance personal shall be provided in each lift car.

#### **15.14 FIREMAN SWITCH**

Lift shall have a Fireman switch with glass front for access by the Firemen. The operation of this switch shall cancel all calls to this lift and shall stop at the next nearest landing if traveling upwards. The doors shall not open at this landing and the lift shall return to the ground floor. In case the lift is traveling downwards when the fireman's switch is operated it shall go straight to the ground floor bypassing all calls enroute. The emergency stop button inside the car shall be rendered in-operative. The fireman's switch shall be located adjacent to the lift opening at the terminal floor and shall be at a height of approximately 2 m above the floor level. For easy identification of firemens lift which confirm to the local authorities requirements, a red and white diagonal striped backing shall be provided behind the glass of the firemen's switch.

A permanent notice of prominent size indicating the floors served shall be provided and displayed adjacent to the firemen's lift at the terminal floor. The notice shall be made of laminated plastic sheet or other approved materials with red letters on white background. Details of the notice shall be submitted to the Architect/Engineer/DFCCIL for approval prior to fabrication.

#### **15.15 CONTROL OF NOISE AND VIBRATION**

##### **15.15.1 General**

The whole of the lift assembly, including the opening and closing of the car and landing doors shall be quiet in operation and shall be free of rattling or squeaking noises. Lift doors operation shall be smooth to avoid the transmission of impact noise to the surrounding structure. Noise level resulting from the operation of the lifts, including direct sound transmission, breakout noise and re-radiation of structure borne noise, shall not exceed the specified noise criteria of the adjacent spaces. Vibration resulting from operation of lifts of escalators shall not be perceptible in any occupied areas.

##### **15.15.2 Car construction**

All elements of the lift car construction shall be sufficiently rigid to avoid generation of noise by panel excitation as a result of movement. The total noise level in a moving lift car shall not exceed 45 dBA with the ventilation system operating.

### **15.15.3 Machinery**

The gearless traction machine and compact PM motor are installed within the hoist way and the slim control panel is located on the shaft side wall. Provision shall be made for the control vibration isolation measures employed to ensure that structure borne noise resulting from the operation of the lift machinery is not audible in any occupied area. Lift machinery noise levels under normal operating conditions shall not exceed 70 dBA at 1 m from the equipment in free field.

### **15.15.4 Arrival chimes**

Noise from arrival chimes shall not exceed 60 dBA.

The above levels shall be measured at 3 m from the arrival chimes using a noise meter set to 'fast' response. Chimes with adjustable loudness shall be provided.

### **15.15.5 FIRE SAFETY REQUIREMENTS**

General requirements of lifts shall be as follows:

- Landing doors in lift enclosures shall have a fire resistance of not less than one hour.
- Lift car door shall have a fire resistance rating of one hour.
- Grounding switch (es), at ground floor level, shall be provided on all the lifts to enable the fire services to ground the lifts.

## **15.16 ASSOCIATED ELECTRICAL WORKS**

### **Scope**

Based on power requirements of lifts furnished by the lift contractor, power supply for the lifts machines, terminating in a Switchboard located at a desired location, shall be provided by IIA. The earth bar provided on this Switchboards shall be connected to the building earthing system. All cabling /wiring/loop earthing beyond this Switchboard for interconnection with the lift controllers / motors/ indicators / push buttons / safety devices etc. shall be provided by the lift contractor and its cost shall be deemed to be included in the quoted rates.

### **Cabling**

Cabling between switchboard and the controller /lift motor shall be with XLPE insulated FR PVC sheathed 1100 volt grade aluminium conductor armoured cables conforming to IS 7098 or PVC insulated, PVC sheathed, 1100 volt grade al conductor armoured cables conforming to IS 1554. Cables shall be terminated in glands fitted with armour clamps the gland body shall be provide with an internal conical sating to receive the armour clamping cone and clamping nuts which shall secure the armour

wires. A PVC shroud shall be fitted to cover the gland body and exposed armour wires. Trailing cables for the lifts shall be EPR insulated stranded copper conductor flexible cables conforming to IS 9968. Control cabling shall be with multi core stranded copper conductor PVC insulated and sheathed 1100 volt grade cables conforming to IS 8130. Minimum size of the cable shall be 2.5 sq mm. Where cables pass through walls or floor slabs, pieces of GI sleeves shall be provided for cast into the wall / floor and cable shall be drawn therein.

### **Wiring**

All wiring shall be carried out with FRLS PVC insulated 1100 volt grade stranded copper conductor wires conforming to IS 694 drawn in MS rigid / flexible conduiting system and / or MS raceways. Minimum 2.5 sq mm size wires shall be used. Wires shall be cut only at terminations. Intermediate jointing shall not be permitted. Drawing, cutting and terminating of the wires shall comply with the relevant Indian standard specifications and shall be carried out in the most workman like manner as per standard practice. All normal care like cutting the insulation with a pencil edge, taking care not to cut the strands and proper tightening of terminal connector screws to avoid loose connection or breaking of conductors etc. shall be taken. Heavy gauge black enameled screw type ISI embossed MS conduits with superior quality accessories approved by Architect/Engineer/DFCCIL shall be used in the work. Conduits could either be recessed in floors / walls or fixed on surface with saddles and clamps. Final connections to vibrating the equipment shall be made with metal flexible conduits. Entire work shall be carried out in work man like manner as per standard practice.

### **Earthing**

Metal enclosures of all electrical equipment and devices including frames of motors, controllers, switchgear, conduits and raceways etc. shall be properly earthed so as to form an equi-potential zone. Loop earthing of vibrating equipment shall be done with flexible copper earthing braid or flexible cables. The lift motor frame shall be connected to the building earthing system termination at the switchboard by duplicate loop earthing conductors of appropriate size.

## **15.17 ASSOCIATED CIVIL & STRUCTURAL ITEMS**

All civil and structural items of work associated with erection and operation of lifts shall be provided by the Contractor at his cost including (but not restricted to) the following.

- Hook for lifting lift equipments in the top of shaft.
- Temporary scaffoldings and safety barricades during lift installation in and around lift Lift wells
- Sill angels

- Bearing plates
- Buffer supports
- Chequered plates
- Fascia plates
- Ladders in pits (MS)
- Safety railing on car top
- Separator /stretcher beams if required .
- Dowels for terminal buffers in pit floor during casting.

The Contractor shall ensure erection and fixing of steel work in such a manner that no RCC wall or any other structural member is damaged.

### **15.18 INSTALLATION**

- a). The LIFT shall be installed as per IS : 1860.

Wiring and earthing shall be extended from the electrical shaft & lift shaft as per requirement.

Power cable & earthing point will be made available at power panel at one location for each lift by other agencies.

- b). All openings at the various landings shall be temporarily guarded during installation.
- c). All safety procedures associated with lifting of heavy equipment, operation of electrical tools & earthing should be strictly complied with.
- d.) All electrical wiring shall have flame resisting moisture proof insulation and will be run in heavy gauge metal conduit/ casing.

The trailing cable between the car and lift well will be multicore type designed for lift services and will have flame resisting moisture proof covering.

Cables should conform to relevant IS amended up to date.

The supply and erection of lift shall conform to the latest lift act in force and modern lift practice in all respects.

All wiring and earthing etc. shall conform to IE rules and regulations

### **15.19 TESTING**

All equipment included in contractor's scope of supply shall be tested at Manufacturer's Works, before delivery and necessary Test Certificates shall be submitted for approval of Consultants.

The Contractor shall carry out all performance tests after installation, in the presence of the Architect/Engineer/DFCCIL, as per specification.

The Contractor shall bear all expenses for such tests.

The Contractor shall be responsible for executing the contract as per Indian Electricity Rules, Rules and Regulations of supply authorities and the Rules of the local Electrical Inspectorate.

Any changes/modifications pointed out by the authorities shall be carried out at no extra cost

## **15.20 OTHER TESTS**

Each elevator shall be tested at site as per IS 4666 & EN 115. Among others, the tests shall include:

- a) Operational tests with functional check on safety devices
- b) Speed of operation at rated load
- c) Overspeed tests.
- d) Leveling accuracy
- e) HV test
- f) Earth resistance.

## **15.21 TAKING OVER OF INSTALLATION**

The equipment & installation shall be deemed to have been taken over by the Client, when the following are completed:

- (i) The Consultants have certified that all contractual obligations have been fulfilled by the Contractor.
- (ii) All performance tests shall be carried out in the presence of client / consultant and Test Certificates are furnished in requisite copies.
- (iii) The installation is approved by the lift inspectorate.
- (iv) The 'As Built' Drawings are submitted. (Hard and soft Copies)

## **16.1 COMPONENTS & ACCESSORIES**

The following components & accessories forming a part of the elevator installation shall be supplied and installed.

All the items shall conform to the requirements of the BIS listed above and the specification.

- (e) Guide rails of steel with working surfaces machined for the car and counter weight.
- (f) Spring buffers located in the lift pit.
- (g) Steel car frame with replaceable guide shoes.
- (h) Lift cars fitted with all interiors, false ceiling, flooring, ventilation fan, lights, operator's panel, floor indicator, Lift mirror, Handrails, emergency stop facility etc.
- (i) Motor operated sliding, center opening car doors wherever applicable.

- (j) Motor operated sliding, center opening landing doors wherever applicable.
- (k) Counter weight with guide shoes.
- (l) Safety gears .
- (m) Speed governors .
- (n) Suspension ropes
- (o) Sheaves & pulleys
- (p) Lift machines
- (q) Controllers & wiring materials
- (r) Terminal stopping and final limits switches .
- (s) Leveling devices
- (t) Lifting beam for machines .
- (u) Any other accessories as required .

Lift Announcement :

The lift shall be provided with special announcements as follows:-

- (a) When supply is out and lift is working in ARD (Automatic rescue device) announcement shall be "supply is out you may alight from the lift as soon as the door opens"
- (b) When supply is out, ARD is not working, and the lift stops in between floors announcement shall be "ARD" is not working please ask help through intercom"

## **17.0 General Technical Specification**

### **17.1 DETAILS OF LIFT WELL**

**17.1.1** The lift well shall be as per clause 5 of IS: 14665.

**17.1.2** There shall be no other opening in the lift well except for the landing openings.

All landing openings in lift well enclosures shall be protected by doors/ collapsible doors, which shall extend to the full height and width of the landing opening

**17.1.3** Light points shall be provided in the lift well at a spacing not exceeding 10m.

All the light points shall have control from the machine room.

socket outlet may also be provided at a suitable place for use by maintenance staff above the ground floor landing.

### **17.2 LIFT PIT:**

The lift pit shall be provided proper water proofing treatment so that the same remains dry.

If the lift pit depth is more than 1 .6m, a ladder to the height of 0.75m above the lift pit floor shall be provided to reach the lift pit.

The lift pit shall have provision for a separate access.

In case of two lifts in the well, one access to the lift pit shall be adequate dividing beam and rigid metal screen to separate each lift from an adjacent lift or its counter weight

a) **GUIDERAILS**

The guide rails shall be as per **IS: 14665**.

Rigid steel guides shall be used for guiding lift car and counterweight throughout its travel.

The strength of the guides, its attachments and the joints shall be sufficient to withstand the forces imposed due to the operation of the safety gear and deflection due to uneven loading of the lift car.

Only machined guide rails shall be provided for passengers and hospital lifts.

The guide tracks shall be supported at suitable intervals and shall be embedded into the walls. Wood or fiber blocks or plugs shall not be used for securing guide brackets.

### **17.3 GUIDE SHOES**

Two numbers of guide shoes at the top and two numbers at the bottom shall be provided on the lift car and counter weight.

Guide shoes shall be provided with adjustable mountings and shall be rigidly secured in accurate alignment at the top and bottom on each side of the car sling and counterweight frame construction.

When oil buffers attached to the bottom of the counterweight are used then additional guide shoes shall be provided on each side of the buffer frame.

For passenger lifts and bed-cum-passenger lifts, sliding guide shoes shall be provided for speeds up to 1.5 mps (meter per second.)

Sliding guide shoes for cars shall be flexible.

Solid guide shoes can be used for counter weights for speeds up to 1.0 mps.

When speed exceeds 1.5 mps, roller guide shoes shall be provided for car and the counterweight,

### **17.4 BUFFERS:**

Buffers shall be provided at the bottom limit of travel for cars and counterweights.

Energy dissipation type buffers shall be used wherever the rated speed of the lift exceeds 1 mps but energy accumulation type buffers shall be preferred if the rated speed of the lift does not exceed 1 mps.



### **17.5 COUNTER WEIGHT:**

The counterweights shall be of metal and it shall be in the form of multiple sections.

It shall be contained and secured within a steel frame and shall be equal to the weight of the complete car plus approx 50% of the rated load.

At least, four guide shoes, capable of being easily renewed or having renewable linings shall be provided on the counterweight.

### **17.6 SUSPENSION ROPES**

Cars and counterweights shall be suspended from round strand steel wire ropes of best quality having a tensile strength not less than 12.5 tonnes/cm<sup>2</sup>.

The size and number shall be in accordance with standard Code of practice/BIS specifications.

Lubrications between the strands shall be achieved by providing impregnated hemp core. The nominal diameter of the ropes shall be at least 8mm.

### **17.7 COMPENSATION ROPES**

For travels over 40 m and/or rated speed of the lift exceeds 2,5 mps, the proven of compensation ropes with tensioning pulleys shall be considered.

For speeds of 2.5 mps or below, quiet operating chains or similar devices shall be used as the means of compensation.

For speeds above 3,5 mps, an anti-rebound arrangement of idler tension pulley shall be provided to prevent the counterweight jumping with the application of the car safety gear.

### **17.8 CAR CONSTRUCTION**

The lift car construction shall be in conformity with Code of Practices, BIS specifications and IE Rules.

#### **CAR FRAME:**

The lift car body shall be carried in a steel car frame sufficiently rigid to withstand the operation of the safety-gear without permanent deformation of the car frame.

The deflection of the members carrying the platform shall not exceed 1/1 000 of their span under static conditions with the rated load evenly distributed over the platform.

### **CARENCLOSURES:**

The whole of the internal face of the car shall be of 1.5 mm thick stainless steel sheet lined.

A suitable backing shall be used to reinforce the car wall panels.

A stainless steel handrail shall be provided on three sides of the lift car, extended to within 150 mm of all corners and a stainless steel skirting panel approximately 100 mm deep shall be provided.

Stainless steel false ceiling with concealed fluorescent light fitting and ventilating fan complete with metal ceiling diffuser shall be provided.

The car ventilation fan shall be switched off within a period which shall be adjustable from 5 to 15 minutes after the last registered call is answered.

The lift car excluding linings, shall be constructed of non-combustible materials. The lift car shall have adequate illumination. The illumination level shall not be less than 150 lux on the lift floor level.

### **EMERGENCY LIGHTING:**

The lift car shall also be provided with emergency lighting operated by a rechargeable battery supply.

The lighting shall be automatically switched on in the event of failure of normal power supply to the lift.

### **CAR PLATFORM:**

The lift car platform shall be designed on the basis of rated load evenly distributed. The dimensions shall conform to IS: 14665 unless otherwise specified. The flooring shall be smooth and non-skid type.

The PVC/rubber flooring of minimum 3mm thickness shall be preferred for passenger and bed- cum-passenger lifts.

The flooring for goods lift shall be strong enough to take the rated load without any deformation or damage.

### **CAR ROOF:**

The car roof shall be solid type and capable of supporting a weight of at least two persons (approx 140 kg) without causing permanent deformation.

Ceiling lights shall be of recessed type and be protected by stainless steel metal bars.

A recessed ceiling fan complete with heavy duty metal diffuser and capable of providing 20 air changes per hour in the car shall be provided.

### **CAR DOORS:**

The doors for passenger lifts shall be of metal and the internal face of the car door shall be suitably lined as the same in the lift car.

The doors shall be in two panels and centre opening with automatic power opening and closing unless otherwise specified.

The car shall be equipped with an electronic door sensor which can detect an obstruction at the car entrances and control the closing of the doors.

The car door shall be provided with an electrical switch which will prevent the lift car from being started or kept in motion unless all car doors are closed.

### **DOOR RE-OPENING DEVICE:**

Door re-opening device shall be fitted to the leading edge of both car door panels, which shall automatically initiate re-opening of the door in the event of a passenger being struck (or about to be struck) by the door in crossing the entrance during the closing movement.

It shall be so designed and installed that for centre opening doors the obstruction of either leading edge when dosing will cause it to function.

### **"DOOR-OPEN" ALARM FOR MANUALLY OPERATED DOORS:**

For manually operated doors and were assisted doors, a 'door open' alarm shall be provided in the car to draw attention to a car or landing door which has been left open for an adjustable period up to 10 minutes.

### **LANDING DOORS**

The car entrance shall be provided with a car door, which shall extend to the full height and width of the car opening.

The opening for the landing doors shall not be wider than that of the lift car. The top track of the door shall not obstruct the car entrance.

All landing openings in lift well enclosures shall be protected by doors / collapsible doors which shall extend to the full height and width of the landing opening.

### **LANDING DOOR LOCKING DEVICE**

Every landing door shall be provided with an effective locking device so that it shall not normally be possible to open the door from the landing side unless the lift car door is in that particular landing zone.

It shall not be possible under normal operation to start the lift car or keep it in motion unless all landing doors are in the closed position and locked.

## **TERMINAL STOPPING AND LIMIT SWITCHES**

The lift shall be provided with normal terminal stopping switches and limit switches. They shall be positively operated by the movement of the car.

These switches shall either be mounted on the car frame or in the lift well.

The limit switches shall either open directly by mechanical separation of the circuits feeding the motor and brake, and provisions shall be made so that the motor cannot feed the brake solenoid, or open, by an electrical safety device, the circuit directly supplying the coils of the two contactors, the contacts of which are in series in the circuits supplying the motor and brake.

## **SAFETY GEAR**

The lift (except service lift) shall be provided with safety gears capable of operating only in the downward direction and capable of stopping a fully laden car, at the tripping speed of the over-speed governor, even if the suspension devices break, by gripping the guides and holding the car there.

## **OVER-SPEED GOVERNOR**

The car safety shall be operated by speed governor located overhead and driven by governor rope suitably connected to the car and mounted on its own pulley.

Over-speed governor shall operate the safety gear at a speed at least equal to 115% of the rated speed.

For rated speeds upto 1 mps maximum governor tripping speed shall be either 140% of the rated speed or 0.88mps, whichever is higher.

For rated speed exceeding 1 mps, maximum governor speed shall be 115% of the rated speed plus 0.25mps.

The means for adjusting the over-speed governor shall be sealed after setting the tripping speed.

## **GOVERNOR ROPES**

The governor ropes shall not be less than 6 mm in diameter and shall be of flexible wire rope.

The rope shall be tensioned by a tensioning pulley and the pulley (or its tension in weight) shall be guided.

The breakage or slackening of the governor rope shall cause the motor to stop by means of an electrical safety device.

The device shall be of bi-stable type requiring manual reset.

## **OVERLOAD DEVICE AND FULL LOAD DEVICE**

The lift shall be provided with an overload device which shall operate when the load in the car is 10% or more in excess of the rated load of the lift.

The overload device, when in operation, shall:-

prevent any movement of the car,

prevent the closing of any power operated door whether fitted to the car or To the landing at which the car is resting, and

give audible and visible signals inside the car.

The lift shall resume normal operation automatically on removal of the excessive load. The overload device shall be inoperative while the Lift car is in motion.

## **FULL LOAD DEVICE**

The lift (other than a service lift) shall be provided with a full load device having an adjustable setting range from 80% to 100% of the rated load and when operated, it shall by-pass all landing calls.

When the load in the car is reduced, the car shall stop for landing calls as normal.

## **EMERGENCY ALARM DEVICE**

An emergency alarm push button together with a buzzer (or an alarm bell) shall be provided in the lift car and connected to the machine room and the main entrance lift lobby and backed up by an emergency supply. The pattern of lift alarms shall be distinguishable from that of fire alarms.

An intercom system connecting the lift car and the machine room /guard room (if manned) shall be provided.

## **EMERGENCY EXIT**

The lift car shall be provided with an emergency exit in the roof of minimum size 500 mm x 350 mm x 400 mm in diameter.

Panels for emergency exits shall: -

be clear of any apparatus mounted above the roof of the lift car

be capable of being opened, re-closed and re-locked without a key

be provided with an electric safety device which will prevent operation of the lift

When the panel is not locked, operate the buzzers (or alarm bells) and also switch off the car ventilation fan.

## **CONTROL AND INDICATION IN CAR**

The lift car shall have a control faceplate made of stainless steel with thickness of not less than 25mm and comprising :-

- (i) Call buttons with acceptance signals to correspond with the landing served
- (ii) An alarm push button with protection from being operated accidentally
- (iii) "Door open" and "Door close" push buttons
- (iv) Audible and visible signals in connection with the over load device
- (v) light switch, alarm reset switch, fan switch and cleaner's " Stop-switch" keeping the car door open in the form of key switches or housed in a recessed metal box with hinged or sliding lid which will be key-locked,
- (vi) Two- way intercom speaker (optional),
- (vii) The control faceplate shall be fixed onto the car panel by stainless steel screws.

For lifts equipped with attendant control, the control faceplate shall also incorporate a non-stop button for the purpose of bypassing landing calls, but the calls shall remain registered until answered. This button shall be inoperative unless the lift is operated by an attendant.

The car direction and position indicator shall be of digital type display with LED's actuated by solid state circuitry unless otherwise specified. The position indicator shall have a minimum height of 50 mm and easy to read even from distance and properly illuminated.

## **17.9 LIFT MACHINERY FOR ELECTRIC LIFT**

### **17.10 LIFT MOTOR**

The induction motor shall be designed to operate for an unlimited period according to the expected duty of the lift.

The motor may be supplied and controlled by static elements when A.C. variable speed system is specified.

### **17.11 MOTOR GENERATOR SET(Not Applicable)**

The motor generator set shall comprise a motor and a generator built as a complete unit directly coupled.

The motor and the generator shall be suitably rated to deal with the load and speed specified.

Controls shall be provided so that the set shall start up on the registration of a landing call or car call and shall continue to run for a period which shall be adjustable from 5 to 15 minutes, after the last registered call is answered.

### **17.12 BEARING AND GEAR CASE**

Bearings shall be of the ball bearing type or sleeve ring type with oil ring bearings. Gear cases shall be provided with thrust bearings suitable for the application.

### **17.13 EMERGENCY OPERATION BY MANUAL DEVICE**

For geared lift machines, the hoisting machine shall be provided with a smooth wheel which may be fitted to the shaft to move the lift car up or down by manual operation.

The direction of movement of the car shall be clearly indicated on the machine.

#### **17.13.1 EMERGENCY OPERATION BY ELECTRICAL SWITCH**

For machines where the manual effort to raise the car together with its rated load exceeds 400N, an electrical switch for emergency operation shall be installed in the machine room.

Directional push buttons protected against accidental operation shall be provided in the machine room such that when the emergency electrical switch is operated,

The car can be moved up or down by applying constant pressure on the buttons. The car speed under the emergency operation shall not exceed 0.63 m/s. The emergency electrical switch and its push buttons shall be so placed that the machine can readily be observed during operation.

#### **17.13.2 ELECTRO-MECHANICAL BRAKE**

Every lift machine shall be provided with a brake which is capable of stopping the machine when the car is traveling at its rated speed and with the rated load plus 25%.

It shall also be fitted with a manual emergency operating device capable of having the brake released by hand while a constant manual pressure is required to keep the brake open.

## **18. GOODS LIFT**

### **18.1 DETAILS OF THE GOODS LIFT CAR**

The side and rear wall panels shall each be provided with three-equally-spaced full length lateral protective wooden battens of 200 mm wide by 25 mm thick.

The surface of the wooden battens shall be covered with 1.0 mm thick metallic sheet as required. The top battens shall be fixed at a height of 1100 mm above finished car floor level.

The car roof shall be able to support the weight of two persons without causing permanent deformation.

Ceiling lights shall be of recessed type and be protected by stainless steel metal bars.

A recessed ceiling fan complete with heavy duty metal diffuser and capable of providing 20 air changes per hour in the car shall be provided.

The car floor shall be constructed of metallic sheet of suitable thickness with 2 mm high multi-grip non-slip pattern.

The floor construction shall be in the form of a metal drain pan (optional).

In case of metallic floor being drain type, the rear and side edges shall be folded up by 100 mm from the floor to form the drain pan.

All joints and the comers of the pan shall be welded to prevent water leakage.

The goods lift cars may also be constructed as mentioned above except the floor drain system.

#### **18.1.1 GOODS LIFT CAR DOOR**

The car doors shall be robust, manually operated, horizontally sliding and made of stainless steel / MS sheet. Power operated, automatic, horizontally sliding doors shall be multi-panel of stainless steel construction, similar to those for passenger lifts, but strong enough for goods lift use.

#### **18.1.2 LIFT CAR AND METHOD OF DRIVE :**

Service lift cars shall be of rigid construction and totally enclosed except for service openings and made of wood or metal and reinforced at the point of suspension.

The car shall not be made of inflammable materials. Two pairs of renewable guide shoes shall be fitted.

Unless otherwise specified, removable shelves shall be fitted inside the car and be so retained that they shall not be displaced by the movement of the car.

The car shall be constructed with openings on opposite sides and shall be provided with some form of protection to prevent the goods from projecting outside the car.

The method of drive for the lift shall be by traction i.e. sheaves and ropes or by positive drive using drum and ropes without counterweights,

#### **18.1.3 GUIDE :**

The car and counterweight shall each be guided by rigid guides.

Guides and their fixings shall be capable to withstand the application of the safety-gear (if provided) when stopping a fully loaded car or counterweight.

#### **18.1.4 BUFFER:**



Buffers shall be provided under all cars and counterweights.

A lift with positive drive shall be provided with additional buffers on the car top to function at the upper limit of travel.

The buffers used shall be one of the following types viz spring, rubber or resilient plastic.

#### **18.1.5 COUNTERWEIGHT:**

Counterweights shall be of metal.

A metal frame shall be provided to prevent their displacement. In the case of drum drive, there shall be no counterweight.

#### **18.1.6 SUSPENSION**

Cars and counterweights shall be suspended by means of round strand steel wire ropes. The factor of safety of suspension ropes shall not be less than 10,

The minimum number of ropes shall be two and they shall be independent.

The diameter of sheaves or pulleys shall not be less than 30 times the rope diameter.

#### **18.1.7 SAFETY GEAR**

Safety gear tripped by an over-speed governor shall be provided for the car where the rated capacity is 250 kg, accessible spaces exist beneath the lift well or gross car roof area equals to or greater than 0.37 m<sup>2</sup>.

Where there is an accessible space beneath the well, the counterweight shall be equipped with safety gear.

#### **18.1.8 LOAD PLATE AND WARNING NOTICE**

A load plate giving the contract load of the lift in kg shall be fixed in a prominent position at each landing entrance.

A warning notice in English, Hindi and local language shall be prominently fixed at each landing entrance.

#### **18.1.9 CAR AND LANDING DOOR**

All landing openings in the lift well shall be protected by doors.

Every car or landing door shall be provided with an electric safety device which shall prevent the lift from being operated when any car or landing door is open.

It shall not be possible during normal operation to open a landing door unless the car is in the unlocking zone.

The landing doors shall be provided with the facility of being unlocked from outside with the aid of a special purpose key provided for use only by a competent lift worker.

### **TERMINAL STOPPING SWITCHES**

Service lifts shall be provided with terminal stopping switches to stop the car automatically at or near the terminal service levels.

### **PAINTING**

All exposed metal parts especially iron parts shall be painted with 2 coats of approved synthetic enamel paint after 2 coats of synchromesh primer after erection and before commissioning the lift.

## **19.0 APPROVAL**

The supplier shall obtain the approval of drawings & installation from the CEIG. Also approval shall be obtained from fire authorities for the features provided.

### **DOCUMENTATION**

The suppliers shall furnish the following documentation in requisite number of copies (one each group of buildings)

- (f) GA drawing of shaft & lift well giving all details to the civil contractors
- (g) Lifting hook size and locations.
- (h) Rail supporting and wall inserts
- (i) Bracket location, shaft ventilation opening size and location.
- (j) Control schematic GA of controllers
- (k) Operation and maintenance manual
- (l) Test certificates.
- (m) As Built drawings.

## **20.0 GUARANTEE**

The equipment supplied and the installation shall be guaranteed for satisfactory performance and workmanship, for a Defect Liability period of 18 months from the date of handing over to the entire satisfaction of client in good working condition and liability of supplier under this guarantee include schedule maintenance as suggested by OEM, factored items repair or replacement of all defective parts if any, which may prove faulty during this period including such parts as may be tendered in operative by wear-and tear but exclude such parts as may be rendered inoperative by vandalism.

The contractor shall replace free of cost all equipment or parts supplied by him and found defective within this period.

In case the contractor fails to replace or render services for defective materials & parts, the client reserves the right to do so, at the contractor's risk and expenses without prejudice.

## **21.0 TESTING OF INSTALLATION**

## **21.1 General**

Inspection and testing of the installation shall be carried out as per Section 10 Part-I of the National Electrical Code 1985 such as:

- (a) Insulation resistance and wiring continuity test.
- (b) Earth resistivity and continuity test
- (c) Test of polarity of non linked single pole switches.

Besides the above any other test specified by the Local Authorities shall also be carried out by the contractor.

All tested and calibrated instruments for testing, labour, materials and incidentals necessary for conducting the test shall be arranged by the contractor at his own cost.

## **21.2 Insulation Resistance Test**

The insulation shall be measured between the earth and whole system of conductors or any section there of with all fuses in place and all switches closed except in concentric wiring, all lamps in position or both poles of the installation otherwise electrically connected together, a direct current pressure of not less than twice the working pressure provided that it does not exceed 660 volts for medium voltage circuits.

Where the supply is derived from the 3 wire (AC or DC) or from a poly phase system. The neutral pole of which is connected to earth, either direct or through added resistance. The working pressure shall deemed to be that which is mentioned between the phase conductor and the neutral.

The insulation resistance measured as above shall not be less than 50 divided by the number of points on the circuit provided that the whole installation shall not be required to have an insulation resistance greater than one megohm.

The insulation resistance shall also be measured between all conductors connected to one pole or phase conductor of the supply and all the conductor connected to the middle wire or the neutral or to the other pole or phase conductor of the supply and its value shall not be less than that specified in above clause.

## **21.3 Testing of Earth Continuity Path**

The earth continuity conductor including metal conduit and metallic envelopes of cables in all cases shall be tested for electric continuity and the electrical resistance of the same alongwith the earth lead but excluding any added resistance or earth leakage circuit breaker measured from the connection with the earth electrode to any point in the earth continuity conductor in the completed installation shall not exceed one ohm.

## **21.4 Testing of Polarity of Non-Linked Single Pole Switches**

In a two-wire installation the test shall be made to verify that all non-linked single pole switches have been fitted in the same conductor through out and such conductor shall be labelled or marked for connected to outer or phase conductor or to the non earthed conductor of the supply.

In a three wire or a four-wire installation a test shall be made to certify that every non-linked single pole switch is fitted in a conductor which is labelled or marked for a connection to one of the outer or phase conductor of the supply.

## 21.5 Load Balancing Tests

After satisfactory completion of the project the contractor has to check balancing of loads by actual measurements for lighting loads only.

## **22. TECHNICAL SPECIFICATIONS FOR MODULAR TYPE UPS SYSTEM FOR 120/160 KVA RATING**

### **1 GENERAL REQUIREMENTS**

#### **1.1 PURPOSE**

These procurement specifications have been written to assist the best technical and financial offer for the supply of **Three Phase Modular True On line Uninterruptible Power Supply (UPS)** with a nominal power of **160 KVA and 120 KVA**, with hermetically-sealed, valve-regulated lead-acid batteries, sized in order to guarantee a minimum **back-up time of 30 minutes on 100% load**.

The bidder must comply with the following Technical Specification, briefed below:

- Topology: On Line Double Conversion VFI;
- Technology: Hi frequency PWM;
- Passing through Neutral;
- Modular Architecture based on suitable VA Power Modules;
- Possibility to configure the system in N+X internal redundancy in the inverter cabinet with one additional power module above the rated capacity of the UPS;
- Equipped with batteries type: lead acid, sealed, free maintenance, VRLA, installed into the system or in a dedicated external battery cabinet. Batteries must guarantee a minimum back up time of 30 **minutes** at 100% of the applied load.

#### **1.2 Conditions**

The offer must comply with requirements presented in this tender, specifying eventual deviations. Deviations must be indicated in the offer documentation; on contrary the requirements will be considered full covered by offered equipment.

#### **1.3 Reference Standards**

The static uninterruptible power system must be designed and produced in compliance with the following international standards:

- EN 62040-1 "General and safety requirements for UPS used in operator access areas"
- EN 62040-2 "Electromagnetic compatibility requirements (EMC)"
- EN 62040-3 "Performance requirements and test methods"

The UPS must have CE marking in accordance with European Directives 73/23, 93/68, 89/336, 92/31, 93/68.

## **2 GENERALI SPECIFICATIONS**

### **2.1 On Line Double Conversion VFI**

The Topology of the UPS must be VFI (Voltage and Frequency Independent accordingly with classification mentioned in the EN- IEC62040-3 Standard), to guarantee filtered and stable output voltage to the load, independently from the input voltage. This means that the output is obtained by two converters in cascade. The first converter rectifies the AC input voltage, the second converter (Inverter) transforms the DC voltage, coming from the rectifier, in AC voltage to supply the load.

This double conversion allows to completely clean eventual disturbs from the mains.

In case of anomalies in the input voltage, the DC voltage, which supply the Inverter, can be obtained, through a booster circuit, from batteries. In this way the output is always guaranteed with continuity. In case of overloads or faults, the automatic static by-pass guarantees the load supply.

### **2.2 Modularity**

The UPS must have modular architectures based on identical power modules which can be interchanged and connected in parallel, inside the UPS cabinet.

Similarly, also batteries must be contained in battery modules (Battery drawers) identical and interchangeable, to be installed in the system in series and parallel to obtain the correct battery voltage and required back up time.

It will be not accepted a system where one or more modules are kept in stand by just as spare to be used only in case of another module failure.

Power modules will be equipped with control and self-diagnostic circuits, to easily individuate the faulty module and the specific failure inside it.

### **2.3 Redundancy N+X**

The UPS must be configurable as N+X power redundant system, with modules of suitable VA contained in same cabinet. In addition to this, one spare module to be provided in the cabinet beyond the specified capacity of the UPS. The cabinet must have space for future power modules in case of future enhancement required.

This kind of redundancy must guarantee continuous supply and protection whenever one module fails. Redundancy must be obtained through the load sharing technology.

### **2.4 Scalability**

The modularity of the UPS must allow to increase the back-up time on site, simply by adding battery drawers. The upgrade will not require factory modifications and will not need dedicated special tools.

UPS should be connected in parallel with similar units to increase Power and redundancy.

## 2.5 Architecture

The architecture of the UPS must be **parallel distributed**, to be more precise, the load will be shared between all power modules. In this way, during normal run, no power module is inactive or in standby. In a redundant configuration, if one module fails all the other ones will take the relevant load without any interruptions or transfer time at the output of the UPS. In case one module failure the power is guaranteed by the other modules.

## 2.6 Adaptability

The UPS should be equipped with a distribution system, for cable connections, which allows the desired In/Out phase configuration by simple jumper connections, without any components replacement or factory settings.

It must be possible to set, independently, In/Out phase configurations as three/three, or three independent single-phase lines.

The In/Out phase configuration will be always possible on site accordingly with the application in terms of utility and loads.

# 3 DESCRIPTION OF THE SYSTEM

## 3.1 POWER MODULE

Each Power Module will be composed by following functional blocs:

- Control
- Rectifier/PFC
- Inverter
- Booster
- Battery Charger
- Automatic Bypass

### 3.1.1 Control

The Control must be equipped with microprocessor of suitable computation power. This control is included on each Power Module and must manage all functions of the UPS and will execute the following jobs:

1. automatic recognition of the number of connected modules;
2. automatic setting of the maximum reactive power that can be provided on the output;
3. individual serial communication with the power modules by a dedicated line;
4. recognition of a faulty module and diagnosis of the relevant fault;
5. synchronization of the output voltage with the input voltage;
6. generation of a reference sinewave curve to form the output voltage wave;

7. control of the PFC, inverter and booster circuits in each power module;
8. management of the automatic bypass;
9. management of the battery runtime (see relative section);
10. management and recognition of the signals and measurements from each module;
11. management of the user interface (see relative section);
12. management and memorizing of UPS history parameters and data;
13. alarm and events memory with association of the time and date of the events themselves.

### 3.1.2 Rectifier/PFC

The rectifier must include a control and regulating circuit (PFC), which in addition to normal rectifying functions will allow the:

- Automatic correction of the power factor to the at value 0.99 (since from the 50% of the nominal load);
- Reduce the Harmonic distortion of the input current obtaining  $THDI_{in} = 3\%$  with nominal load

### 3.1.3 Inverter

The inverter must be based on a switching IGBT circuit with High Frequency PWM, and must be able to transform the DC supply, coming from rectifier/PFC or booster, in case of battery run, in AC voltage.

Furthermore, must be present also control circuits which guarantee:

- Arrest and protection of the inverter in case of strong and long overloads;
- Keep the harmonic distortion of the output voltage less than 1% ( $THD_{out} < 1\%$ ) either in normal run than in battery run;
- Arrest and protect the inverter in case of over temperature of power converters elements;
- Manage the speed of the Fans accordingly with internal temperature and applied load;

### 3.1.4 Booster

The “booster” must transform the battery DC voltage from the nominal value of 252 Vdc, to the dual, positive and negative buses, with middle point referred to the passing through neutral. From the positive bus the inverter will obtain the positive half period of the output voltage sine wave, from the negative bus the inverter will obtain the negative half period of the output voltage sine wave.

Protection circuits must be present on the booster to protect the booster circuit in case of strong overload.

### 3.1.5 Battery Charger

The Battery Charger must be equipped with control and regulation circuit both for charging voltage and current to batteries, to have a controlled battery charge and optimize the battery life.

The UPS must charge batteries with early boost charge followed by a constant charge and, at the end, with a floating charge. During normal run the UPS will execute periodically a battery equalizing to recover natural charge leakages and keep all batteries at the same capacity. This battery charging cycle will increase the batteries life time, with relevant reduction of the maintenance costs.

The battery recharge must be available even when UPS is turned off.

### **3.1.6 Automatic Bypass**

The Automatic bypass must be composed by following parts:

- Static switch with zero time for intervention, connected in parallel with an electro-mechanic switch which needs a transfer time but with zero heat dissipation among the time;
- Microprocessor Logic command and control which will attend to:
  - Automatically transfer the load to the mains, as soon as following anomalous events occur: overload, over temperature, voltage runaway on the DC buses, anomalies on the inverter; Automatically transfer back the load from the mains to the inverter as soon the anomalous event expires;
  - Automatically disable the bypass function in case of output voltage and Mains are not synchronized.

## **3.2 Batteries**

### **3.2.1 Battery Type**

The hermetic, maintenance-free stationary lead batteries are housed in the UPS and/or in one of more cabinets of the same shape and size as that of the UPS itself. The positive and negative battery connections are protected by an adequate fuse-holder isolating switch.

### **3.2.2 Battery Module (Drawer)**

A drawer comprises of 12V batteries of suitable Ah connected in series to achieve the desired back up time. The drawer must comply with CEI-EN 60950 standards governing electrical safety, which requires the use of adequate protections and particular care when dangerous voltages higher than 50 Vdc are present and direct contacts are possible. The runtime can be increased to a further extent by adding more battery drawers in multiples of two, using both the housings in the UPS and those pre-engineered in the additional “modular cabinets”.

### **3.2.3 Battery management**

The following functions must be available:

Conduction of the battery test either automatically or upon the user’s request.

Battery efficiency test conducted by making an automatic full discharge at programmed or periodic frequencies, as required by the user. The battery is discharged by use of an appropriate algorithm with discharge curve control to monitor the performance and status of the batteries.



Calculation of the residue battery runtime during the discharge phase, depending on the load applied.

To protect the batteries from damage due to deep discharges<sup>1</sup> the minimum tolerated battery voltage limit<sup>2</sup> is automatically changed to suit the applied load (default setting), while allowing the user to select a type of management with fixed voltage limits.

The “average” battery life is 4-6 years.

### 3.3 Digital Display Alarm signal

UPS will be equipped with a LCD touch screen display. This display is built into the front part of the UPS and should be able to rotate of 180° to facilitate all operations during commissioning and service. An ultra- bright operating status indicator, which shows the operating status and any alarm conditions by means of a traffic light code, should be present on this display.

The display allows the user to:

- display the operating data;
- enter the operating parameters;
- select the language in which the messages are given;
- set running parameters;
- others.

## 4 OPERATING PRINCIPLE

The purpose of this section is to define the various operating conditions of the UPS.

### 4.1 Normal service condition

In normal conditions, UPS runs in the double conversion on-line mode, thus the users are powered in an uninterrupted way by the inverter, which is powered by the electricity main through the AC/DC converter (rectifier/PFC) that automatically corrects the power factor on the UPS input as well.

The inverter is constantly synchronized with the electricity main to allow the bypass to function correctly during mains/inverter and inverter/mains commutations. These commutations may be necessary if an overload occurs or if the inverter stops.

The battery charger in each power module provides the power required to keep the battery charge at an optimum level.

### 4.2 Inverter stopping or overload

#### 4.2.1 Inverter stopping

If the inverter stops, the user is automatically transferred without interruptions to the primary main by means of the automatic bypass.

#### 4.2.2 Overload

When a temporary overload occurs on the load side of the UPS, current monitoring allows the UPS to withstand the situation within certain limits, without the automatic bypass having

to be used: if the overload lasts a long time or exceeds the limits preset by the current monitoring device, the user is transferred without interruptions to the primary main by means of the automatic bypass and then returns to the inverter once the overload has terminated.

#### **4.2.3 Bypass activation sensitivity adjustment**

Bypass activation, based on the length of time "loss of voltage" on the output lasts, can be regulated by the user in discrete steps to facilitate use of UPS together with equipment characterized by frequent surge currents. This adjustment can be carried out by the user from the front panel or by means of the diagnostic software installed on an external PC.

#### **4.2.4 Inverter stopping in a Power Module**

The modular architecture, with N+X redundant configuration, allows energy to be supplied to the load even if the inverter of a power module stops.

The nominal power represented by the sum of the functional modules can always be supplied to the user, which can work at reduced load or full load in the case of a redundant configuration. The inverter stopped condition is detected by the monitoring logic, is transmitted to the microprocessor and is then signaled to the user on the frontal display or via software. Each power module also has a LED that immediately signals its operating status. This allows the damaged module to be immediately identified and facilitates the replacement operations.

### **4.3 Emergency condition (Mains failure)**

In a blackout, or if the electricity main values are off range, the users are powered by the batteries via the booster-inverter pathway. The batteries function in discharged conditions in this operating mode.

The UPS informs the user about this operating status with clear visual and acoustic signals.

Due to diagnostic-predictive algorithm, the microprocessor control can calculate the available residual runtime depending on the instantaneously applied load. This runtime is shown on the frontal display of the unit with a reasonable degree of accuracy.

### **4.4 After a blackout**

When the electricity Mains power returns within the tolerated limits after a voltage drop or a blackout, the UPS automatically returns to operate in normal service conditions absorbing electricity from the Main.

Even after the end of autonomy, at the return of the Mains the battery charger automatically starts to charge batteries.

### **4.5 Smart Eco Mode**

To save Energy in particular conditions the UPS must be easily set by the user to run in Eco Mode. In this running mode the load is directly connected to the utility. In the meantime, the UPS is continuously checking the mains Energy supply, as soon the input Energy is out of tolerance, the UPS immediately switches in on line mode.

**4.6 Cold Start**

The UPS must be able to be start up without the input mains, just using batteries (Cold Start Function).

**4.7 Start Up on Bypass**

The UPS must be able to connect the load directly on bypass during the startup (start up on bypass) and then connect the load to the inverter output when the inverter is full synchronized with the input Mains.

**4.8 Maintenance Bypass**

The UPS will be equipped with a manual maintenance bypass to allow the service and the access to modules and battery, keeping the load powered. The maintenance bypass can be activated manually and must be protected by a door locked with a key.

A disconnectors system must isolate the internal parts of the UPS from any energy source allowing the UPS maintenance, service and access to modules without danger.

**4.9 Operation with a genset or as a frequency converter**

The output frequency of UPS is synchronized with the mains input frequency. This synchronizing process is guaranteed by the microprocessor control within a  $\pm 0.5\%$  range of the nominal frequency (50 Hz). Out of this range, the UPS stops the synchronizing with the input frequency and guarantees a strictly constant output frequency. (in this condition of asynchrony between the input and output, it is essential for the automatic bypass to be disabled).

**4.9.1 Genset**

To achieve optimum operation in combination with generators or gensets, typically characterized by frequency fluctuations exceeding the  $\pm 0.5\%$  range, the UPS must have the possibility to guarantee synchronism between the input and output frequency for even wider frequency ranges, not less than  $\pm 14\%$ . Normally, when the UPS runs in synchronism, the automatic bypass must be enabled.

**4.9.2 Asynchronous operation**

As a consequence of characteristics 1.5.1 and 1.5.3, with the appropriate settings, the UPS can run in asynchronous conditions generating to the output a constant frequency, within a maximum  $\pm 1\%$  range whenever the input frequency is variable.

This operating mode allows the UPS to work with input Mains supply with extremely variable frequencies, guaranteeing a constant output frequency at both 50 Hz and 60 Hz.

**4.10 Data availability when UPS is Off**

The UPS will allow the possibility to make settings, data readings and diagnostic checks also when it is turned off, activating the display in a temporary service mode.

## 5 Controls

### 5.1 Controls

The UPS has the following controls:

- UPS secure powering (protection against accidental powering);
- UPS stopping (to prevent accidental power-offs while allowing the UPS to be quickly shutdown in an emergency.);
- buzzer silencer;
- Different levels of password on the display to protect setting of advanced parameters.

### 5.2 Measurements

The UPS can manage the following measurements and show the relevant values on the display:

INPUT	OUTPUT	BATTERIES	MISCELLANEOUS	HISTORIC DATA
Current: <ul style="list-style-type: none"> <li>▪ Root-mean-square value</li> <li>▪ Peak value</li> <li>▪ Peak factor</li> </ul> Voltage: <ul style="list-style-type: none"> <li>▪ Root-mean-square value</li> </ul> Power: <ul style="list-style-type: none"> <li>▪ Apparent</li> <li>▪ Active</li> </ul> Power factor Frequency	Current: <ul style="list-style-type: none"> <li>▪ Root-mean-square value</li> <li>▪ Peak value</li> <li>▪ Peak factor</li> </ul> Voltage: <ul style="list-style-type: none"> <li>▪ Root-mean-square value</li> </ul> Power: <ul style="list-style-type: none"> <li>▪ Apparent</li> <li>▪ Active</li> </ul> Power factor Frequency	<ul style="list-style-type: none"> <li>▪ Charging current</li> <li>▪ Discharging current</li> <li>▪ Battery operation time</li> <li>▪ Residue capacity</li> <li>▪ Battery voltage</li> <li>▪ Date/time of last battery calibration</li> </ul>	<ul style="list-style-type: none"> <li>▪ Internal temperature of individual power modules</li> <li>▪ Ambient temperature</li> </ul>	<ul style="list-style-type: none"> <li>▪ N° of bypass interventions</li> <li>▪ N° thermal protection interventions with date and time</li> <li>▪ Number of battery commutations</li> <li>▪ Number of total discharges</li> </ul> Overall time of: <ul style="list-style-type: none"> <li>▪ Battery operation</li> <li>▪ Mains operation</li> </ul>

### 5.3 Adjustments

The will UPS allow the following adjustments to be made and shown on the display:

OUTPUT	INPUT	BYPASS	BATTERIES
<ul style="list-style-type: none"> <li>▪ Voltage</li> <li>▪ Frequency</li> <li>▪ Redundancy</li> </ul> N+X	<ul style="list-style-type: none"> <li>▪ Enable synchronizing</li> <li>▪ Extended synchronizing interval</li> </ul>	<ul style="list-style-type: none"> <li><input type="checkbox"/> Enabling</li> <li><input type="checkbox"/> Forced</li> <li><input type="checkbox"/> Actuation sensitivity</li> <li><input type="checkbox"/> Off line mode</li> </ul>	<ul style="list-style-type: none"> <li><input type="checkbox"/> Limits</li> <li><input type="checkbox"/> Max. runtime with battery</li> <li><input type="checkbox"/> Max. runtime with battery after reserve limit</li> </ul>

		<input type="checkbox"/> Load waiting mode	<input type="checkbox"/> Battery test enabling <input type="checkbox"/> Auto-restart enabling
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## 5.4 Signals and alarms

The UPS must be equipped with a lighted operating status indicator with traffic light coding on the display and on each Power Modules well as a buzzer able to immediately indicate the following operating conditions:

- normal operation (on line)
- output frequency not synchronized with the input
- battery operation
- bypass mode
- faulty power module
- overload
- generic fault
- programmed power-off warning
- programmed re-powering warning
- runtime reserve
- end of runtime
- etc.

## 5.5 Miscellaneous equipment

### 5.5.1 Interfaces

The UPS shall also equipped with:

- terminals for connecting the EPO (Emergency Power Off button);
- 8 outputs contacts to be set NC or NO by operator panel;
- 10 input contacts to be set NC or NO by operator panel;
- Slot for an SNMP interface that allows the UPS diagnostics, remote control via the network and computer remote shutdown within the battery runtime.
- Terminals of contact for external Back Feed protection, to be set NC or NO
- The USB HOST port is needed for firmware updates.
- The USB UART port is for maintenance purposes.
- The input contact EXT TEMP for the external temperature
- The input contact GENSET allows the UPS to know if there is an external generator. If the contact is closed, the generator is present.

### 5.5.2 E.P.O. (Emergency Power Off)

The UPS is equipped with an input for a normally closed button (NC). Use of this button immediately stops the whole UPS functions and immediately shuts off the output energy.

### 5.5.3 Communication port

The UPS must have USB port:

The USB Port allows to connect the UPS to a Computer and remotely manage the UPS operating functions by a dedicated software.

The USB UART port also allows to connect the UPS to a Computer to execute service and maintenance operations as data reading, diagnostic checks, event memory download, firmware update.

#### **5.5.4 Mimic panel**

A mimic panel shall provide the user with visual signals (using LEDs and an LCD) and acoustic signals (using a buzzer) about the status of the UPS. It shall also allow the control, monitoring, diagnostic and customisation of the UPS through easy access to the display menus. The list is given below:

##### **Measurements:**

input voltages	input frequency
by-pass voltage	by-pass frequency
battery voltage	battery current (charge/discharge)
output voltage	output frequency
Output currents	output power
output peak currents	back-up time
system temperature	heat sink temperature

##### **Controls:**

start-up (power load)	shut-down
load on by-pass	load on inverter
battery test	

##### **Customisation set points**

Nominal output frequency	nominal output voltage
operating modes	delay on start-up
shutdown due to minimum load	acoustic alarm off
Battery expansion (external)	sensitivity in Line Interactive mode

##### **Log:**

It shall be possible to store up to 960 events in FIFO (First In First Out) mode.

#### **5.5.5 Monitoring and shut-down software included**

The system must have the relative software to guarantee effective and intuitive management of the UPS, displaying on bar graphs all the most important items of information such as input voltage, applied load, battery capacity, etc.

The software must be able to give detailed information also in cases of UPS failure, in support of the failure diagnostic.

It shall be developed with a Client/Server architecture, making it flexible and easy to manage, and provided with multi-language support and online help.

The software shall be provided free of charge with the UPS having an SNMP agent included, for the Windows 95, 98, 2000, Me, XP, NT4.0, Novell, Linux, MacOS 9.x, OSX operating systems.

The Software must also be able to program the weekly start-up and shut-down of the UPS, in automatic mode.

### 5.5.6 Main features of the Software

The Software must have the following main features:

#### ***Sequential and prioritised shut-down:***

The software shall have to perform the unmanned shut-down of all the networked PCs, saving all active work in the most widely used applications. The user can define his/her own shut-down procedures, also establishing priority for the shut-down of critical computers (such as servers).

#### ***Multiplatform compatibility:***

The software shall enable standard management and monitoring, using the TCP/IP communication protocol. This shall make it possible to manage hardware (servers and PCs) having different operating systems.

#### ***Events scheduling:***

The software shall allow the definition of shutdown/power-off and switch-on processes for the connected loads, for enhanced system security and energy savings.

#### ***Messages management:***

The software shall have to constantly inform the user about the status of the UPS, both locally and by sending messages to network users; moreover, it shall be possible to define a list of users who shall receive messages, emails, faxes and SMS in case of unexpected faults or mains power supply failures.

#### ***Integrated SNMP agent:***

The software must contain an integrated SNMP agent for management of the UPS via SNMP.

This agent shall be able to send all the information concerning the UPS and to generate traps using the RFC 1628 MIB standard.

This shall allow management of the UPS in compatible SNMP management stations such as HP Open View, Novell Managewise and IBM NetView.

## 6 Technical specifications

Item	Data
6.1	General Specifications

UPS Topology	True On line double conversion
Architecture of the UPS	Modular, Scalable, Decentralized Parallel Architecture (each Module 25-50 KVA)
In/Out phase Configuration	Three phase-Three phase
Neutral	Neutral Passing through
Bypass type	Static and electromechanics
Input Phase Reversal Correction	Yes
<b>6.2 Input</b>	
Nominal Voltage	400 V three phase / 230V single phase
Voltage range	-20% +15%
Frequency	50 Hz o 60Hz (autosensing)
THDI <sub>in</sub>	< 3% al 100% of nominal load
Power Factor	> 0.99 from 50% to 100% of nominal load
<b>6.3 Output with mains (AC-AC)</b>	
Nominal voltage	400 V three phase
Nominal power	160,000 & 120,000 VA
Active power	160,000 & 120,000 W
AC-AC Efficiency (On Line)	up to 96,5%
Voltage variation (static)	< 1%
Voltage variation (dynamic 0-100%; 100-0%)	< 1%
Frequency	50 Hz or 60 Hz (autosensing or selectable)
Frequency tolerance	Synchronized with input frequency or < 1% free run
Current Crest Factor	3:1 accordingly with IEC EN62040-3
Overload Capability	10 min: upto 125% or 1 min: upto 150%
<b>6.4 Output in battery Run (DC-AC)</b>	
Nominal voltage	400 V three phase
Nominal power	160,000 & 120,000 VA
Active power	160,000 & 120,000 W
DC-AC Efficiency	up to 96,5%
Voltage variation (static)	< 1%
Voltage variation (dynamic 0-100%; 100-0%)	< 1%
Frequency	50 Hz o 60 Hz (autosensing or selectable)
Frequency tolerance	< 1% free run
Current Crest Factor	3:1 accordingly with IEC EN62040-3
Overload Capability	10 min: upto 125% or 1 min: upto 150%
<b>6.5 Battery</b>	
Type	Lead Acid, sealed, free maintenance VRLA
Unit Capacity	9 Ah, 11 Ah (12V)
Nominal UPS Battery Voltage	+/-288 Volt DC (48 blocs), configurable from +/-264 to +/-312 VDC (44-52 blocs)
Battery charger type	PWM hi efficiency, one in each power module
Charging Cycle	Intelligent with boost charge and advanced



	management
Max Charging Current	5 A each power module
Independent battery configuration (max)	5 set (one for each power module installed)
<b>6.6 Environmental specs</b>	
Noise level @ 1m	<80 dBA
Working temperature range	from 0°C to +40°C
Stock temperature range	from -20°C to +50°C (excluded batteries)
Humidity range	20-95% not condensing
Protection degree	
<b>6.7 Mechanical and Miscellaneous</b>	
Technology rectifier/booster/inverter	MOSFET/IGBT
LCD Display	Yes (Per module)
LEDs	LED for notification and alarms
Communication Ports	USB, RS485 (User)X1, RS485 (Maintenance)X1, SNMP Slot, Potential free contacts
Input/Output connections	3P + N + PE Connectors on omega bar
Standards	EN 62040-1, EN 62040-2, EN 62040-3

The UPS Manufacturer Company must have ISO9001 certification for development, production, and services.

## 7 DOCUMENTS

The product Technical Specifications must be provided with the offer and must contain the following information:

- product features
- product technical data
- installation instructions
- information available on the mimic panel
- list of options available

A user guide must be supplied with the product, providing information on the installation and use of the equipment.

## 8 PACKAGING

The packaging, provided by the supplier, must ensure that the product reaches its destination intact and in working order.

## 9 COMMISSIONING AND INSTALLATION

The installation of the product will be carried out by the supplier who will also supply the proper instructions on the use of the unit.

## 10 REMOTE SERVICE

Upon request, the supplier shall ensure remote supervision of the equipment 24 hours a day. The supplied products must therefore be able to share information via modem and to

communicate with the authorised Service Centres so that they can periodically test the system and check present and past operating parameters, automatically sending a report to the user.

The UPS must be able to call the Service Centres automatically to signal possible alarms or failures and to ask for the immediate intervention of the Service Centre.

**TECHNICAL SPECIFICATIONS FOR PLUMBING WORKS**  
**(SECTION-4)**

## **SECTION-I: BASIS OF DESIGN**

### **1. BASIS OF DESIGN**

The internal Plumbing, Sanitary, Drainage System for the project is designed keeping in view the following:

- 1.1 Requirement of adequate and equal pressure availability of hot and cold water lines in public/common toilets and kitchen (sinks) will be already installed.
- 1.2 Adequate storage of water in underground raw and treated domestic water tanks, already exist at the site. The works execution and materials used shall be as per the latest relevant I.S. specifications.

Wherever reference has been made to International Standards or any other specifications, the same shall mean to refer to the latest specification irrespective of any particular edition of such specification being mentioned in the specifications below or in Schedule of Quantities.

### **2. CONCEPT OF THE SYSTEM**

The following services are envisaged for the tender:

- 2.1 Soil/waste & water supply lines are already exist at the fixture level.
- 2.2 All sanitary items to be supplied & installed considering drawings & site conditions.
- 2.3 The Contractor shall visit the site and shall satisfy himself as to the conditions under which the work is to be performed. He shall also check and ascertain the location of any existing structure or equipment, or any other situation which may affect the work. No extra claim as a consequence of ignorance or on ground of insufficient description will be allowed at a later date.

### **3. PLUMBING/SANITARY WORKS:**

#### **3.1 GENERAL:**

- 3.1.1 The work shall be carried out in the accordance with the drawings and design as would be issued to the Contractor by the Architect/Design Consultant.
- 3.1.2 The work shall be executed and measured as per metric dimensions given in the Bills of Quantities, drawings etc.
- 3.1.3 The Contractor shall acquaint himself fully with the partial provisions for supports that may or may not be available in the structure and if they are available then he utilize them to the extent possible. In any case the Contractor shall provide all the supports regardless of provisions that they have been already made. Nothing extra shall be payable for situations where insert plates (for supports) are not available or are not useful.
- 3.1.4 Shop coats of paint that may be damaged during shipment or erection shall be cleaned off with

mineral spirits, wire brushed and spot primed over the affected areas, then coated with paint to match the finish over the adjoining shop painted surface.

- 3.1.5 The Contractor shall protect/handle the material carefully and if any damage occurs while handling by the Contractor then the sole responsibility shall be of the Contractor. Such damages shall be rectified/ recovered by the Contractor at no extra cost whatsoever.
- 3.1.6 The Contractor shall, where applicable, complete the submission of shop drawings to the Architect/Engineer/DFCCIL for approval in order to conform to the contract schedule.
- 3.1.7 Measurements:  
All measurements shall be taken in accordance with relevant codes, unless otherwise specified.

#### **4. SANITARY FIXTURES & PIPE FITTINGS**

##### **4.1 SCOPE:**

Work under this section shall consist of transportation, furnishing, installation, testing and commissioning and all labour as necessary as required to completely install all sanitary fixtures, brass and chromium plated fittings, and accessories as required by the drawings and specified hereinafter or given in the Bills of Quantities.

##### **4.2 General Requirements**

All fixtures and fittings shall be fixed with all such accessories as are required to complete the item in good working condition, whether specifically mentioned or not in the Bills of Quantities, specifications, and drawings.

All fixtures and accessories shall be fixed in accordance with a set pattern matching the tiles or interior finish as per architectural design requirements. Wherever necessary the fittings shall be centered to dimensions and patterns desired.

Fixing screws shall be half round head chromium plated brass with C.P. washers wherever required as per directions of Architect/Engineer/DFCCIL.

All fittings and fixtures shall be fixed in a neat workmanlike manner true to levels and heights shown on the drawings and in accordance with the manufacturers' recommendations. Care shall be taken to fix all inlet and outlet pipes at correct positions. Faulty locations shall be made good and any damage to the finished floor, wall or ceiling surfaces, shall be made good at Contractor's cost.

All fixtures of the similar materials shall be by the same manufacturers.

All fittings shall be of chromium plated materials.

Without restricting generally to the foregoing, Sanitary Fixtures shall include all sanitary fixtures, C.P. fittings, and accessories etc. necessary and required for the building.

Whether specifically mentioned or not, all fixtures and appliances shall be provided with approved fixing devices, nuts, bolts, screws, hangers, etc. as required. These supports shall have the necessary adjustments to allow for irregularities at the construction site. For the installation of the

CP fittings, Teflon tape shall be used.

#### 4.3 **EUROPEAN W.C:**

European W.C. of glazed vitreous china shall be wash down, single or double siphonic type, floor or wall mounted set, flushed by means of flush valve as specified in the Bills of Quantities. Flush pipe/bend shall be connected to the W.C. by means of suitable rubber adopter. Wall hung W.C. shall be supported by C.I. floor mounted chair.

Each W.C. seat cover shall be so fixed that it remains absolutely stationary in vertical position without falling down on the W.C. Seat cover shall be of white solid plastic, elongated open front with heavy duty hinges. Exposed fixture trims shall be Chrome plated, and trims of similar function shall be by the same manufacturer.

Flush valves shall be of the best approved quality procurable with C.P. control valve and C.P. flush pipe.

The flush pipe/bend shall be connected to the W.C. by means of a suitable rubber adopter.

#### 4.4 **FLUSHING CISTERN:**

Alternatively flushing cistern to be used shall conform to the requirements. High level cisterns shall be of cast iron unless otherwise specified. Low level cistern shall be of the same material as the water closet or as instructed by the Architect/Engineer/DFCCIL. The cisterns shall be mosquito proof & shall fulfill the requirements of the local Authority.

The levels of the W.C. should be checked by placing spirit level on the W.C. W.C. should be tested on completion of fixing by putting small paper balls and flushing out. If all the paper balls are not flushed out. The fixing will have to be rectified / re-aligned.

#### 4.5 **URINALS:**

Half stall wall hung urinals of glazed vitreous china shall be provided with 15mm dia. C.P. brass spreader, 32mm dia. C.P. domical waste, and C.P. cast brass bottle trap with pipe and wall flange, and shall be fixed to wall by one C.I. bracket and two C.I. clips as recommended by manufacturers and as directed by the Architect/Engineer/DFCCIL.

Urinals shall be flushed by means of “NO-TOUCH” infrared operated flush valves.

Waste pipes for urinals shall be any one of the two below given materials and as directed by the Architect/Engineer/DFCCIL:

- G.I. Pipes
- Rigid PVC/High density polyethylene.

Waste pipes may be exposed on wall or concealed in chase as directed by the Architect/Engineer/DFCCIL.

**4.6 URINAL PARTITIONS:**

Urinal partitions shall be white glazed vitreous china, marble, granite or any other material selected by the Architect/Engineer/DFCCIL.

Urinal partitions shall be fixed at proper heights with C.P. brass bolts, anchor fasteners, and M.S. Clips as recommended by the manufacturer and directed by Architect/Engineer/DFCCIL.

**4.7 WASH BASINS:**

Wash basins shall be of white vitreous china of best quality manufactured by an approved firm and sizes, and as specified in the list of makes.

Wash basin shall be of table top / under counter drop in type shall be supported on a pair of rolled steel brackets of approved design and shall be mounted on a countertop so that rim and basin bowl are exposed from top.

Wash basin shall be provided with chromium plated brass bottle trap of approved quality, design and make, where hot water required. Single tap where hot water is not required.

Wash basin shall be fixed at proper location and height and truly horizontal as shown on drawing or as directed by Architect/Engineer/DFCCIL.

**4.8 BOTTLE TRAPS**

Bottle trap (for wash basins, sinks, urinals etc.) shall be deep seal (minimum 60mm water seal) cast brass Bottle, heavy chromium plated. All bottle traps shall be provided with suitable cleaning eye, extension Piece, flare nuts, all chromium plated. Bottle traps shall be of approved make and design. Traps for washbasins, urinal and sinks shall be 32mm

**4.9 PILLAR COCK / BASIN MIXTURE**

As per OEM (Original Equipment Manufacturer) / Manufacturer's standards.

Wash basin shall be provided with single lever mixer where hot water required. Pillar cock where hot water is not required.

**4.10 SINKS:**

Sinks shall be of stainless steel material as specified in the Bills of Quantities/Drawings.

Each sink shall be provided with R. S. brackets and clips and securely fixed. Counter top sinks shall be fixed with suitable angle iron clips or brackets as recommended by the manufacturer. Each sink shall be provided with 40 mm dia. Chromium Plated waste with chain and plug or P.V.C. waste with Escutcheon plates. Fixing shall be done as directed by Architect/Engineer/DFCCIL.

Supply fittings for sinks shall be mixing fittings or C.P. taps, angle cocks etc. all as specified in the Bills of Quantities/Drawings.

**4.11 SINK BIB COCK / SINK MIXTURE**

These shall be chromium plated brass heavy quality and shall be easy type with capstan head. The size shall be as specified in the Bills of Quantities.

Supply fittings for sinks shall be mixing fittings where hot water required or long body bib cock where hot water is not required, all as specified in the Bills of Quantities/Drawings.

**4.12 HEALTH FAUCET/SPRAY**

A chromium plated spray with integral hand control valve and connected to a flexible pipe and angle valve with wall flange and hook are fixed as shown on the drawings or as directed by the Architect/Engineer/DFCCIL. The angle valve and flange shall be paid under relevant item.

**4.13 ANGLE VALVE**

As per OEM (Original Equipment Manufacturer) / Manufacturer's standards.

**4.14 HOSE CONNECTION**

As per OEM (Original Equipment Manufacturer) / Manufacturer's standards.

**4.15 2 WAY BIB TAP**

These shall be chromium plated brass heavy quality of "EGO" type or equivalent, and shall be easy type with capstan head. The size shall be as specified in the Bills of Quantities.

**5.0 ELECTRICAL WATER HEATER:**

The Electric Water Heater shall be a complete package unit ready for plumbing and electrical service conditions. It shall be insulated with heavy duty 50 mm thick fiberglass blanket insulation and high gloss enamel finish outer shell. Electric Heating Coil rating and storage capacity shall be as shown on drawings.

Vertical pressure type electric water heaters shall be suitable for a minimum working head of 10 bars.

Construction: Inner containers shall be coated with glass, fused to steel at 870°C. This glass should provide corrosion resistance for steel.

Elements brazed to detachable brass heater plate, the whole being easily replaceable when required.

Heating elements constructed of a nickel chromium resistance wire, sheathed in a mineral filling, the whole being encased in a copper tube and subjected to a high voltage test of 1750 volts. Heater shall be supplied with adjustable setting thermostat including high temperature safety cut-out and over-pressure relief valve, drain point, electrical point, temperature indication, pilot indication, and necessary ancillaries.



## SECTION-II: SOIL, WASTE VENT & FITTING

### 1 Noise Insulated Piping System

#### 1.1 SOCKET PIPES

Three Layer sound insulated Polypropylene piping (PP) system as per ON EN 1451-Part 1-6 & EN 12056 Part 1-5 with 3 layer pipe made of PP-C + PP-MV + PP-C in Blue Ral 5014 (halogen and calcium free) colour, push-fit type, food safe, having high impact and stiffness, offering sound levels of not more than 21 dBA with POLO clip HS/ 22 dBA with Bismat 2000 clamp /equivalent and 16 dBA with Bismat 1000 clamp/equivalent as per DIN 4109 at a flow rate of 4 l/s and having pipe ring stiffness as per ISO/DIS 9969 and tightness as per EN 1277/B and C and DIN 19560, density = 1.25gms/cm<sup>3</sup>, elongation = 0.05mm/m0K and tensile strength > 24 N/mm<sup>2</sup>, with all necessary fittings in blue colour, fitted with factory fitted lip ring, having 3 layers, pipes to be painted with ordinary cement paint for external installation:

➤ **INTERNAL LAYER:**

Of PP-C, hot water resistant to 97 degree C, tested in accordance to ON EN 1451-1 and DIN 19560, good heat and corrosion ageing stability as well as high chemical resistance and a smooth pipe inner-surface.

Color: Blue (halogen and calcium free)

➤ **INTERMEDIATE LAYER:**

Of PP-MV compound reinforced with mineral aggregate, which guarantees greater stiffness and stability.

Color: Grey.

➤ **EXTERNAL LAYER:**

Of PP-C. With high impact resistance and good weathering resistance.

Color: Blue (halogen and calcium free)

#### 1.2 PIPE RING STIFFNESS:

Pipe ring stiffness would be in accordance with ISO/DIS 9969 and TIGHTNESS as per EN 1277/B and C and DIN 19560.

#### 1.3 MARKINGS:

All pipes shall carry the following markings: Batch number; year and week of manufacture; company name; dimension application class; stiffness class, test mark and material details.

#### 1.4 FITTINGS:

Single- Layered fitting reinforced with mineral aggregate, made of a Halogen free PP-C-KV synthetic material, a reinforced wall and factory fitted lip ring, hot water resistant upto 95 degree C in accordance to ON EN 1451-PART 1-6 EN 12056 PART 1-5. Color: Blue (halogen and calcium free)

#### 1.3 INSTALLATION:

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

Minimum supporting:

Nominal outer diameter DN/OD mm	Bracket distance	
	Horizontal pipe routing*) D max. m (max. 1.5 x da)	Vertical pipe routing*) D max. m
32	0.5	1.50
40	0.6	1.50
50	0.75	1.50
75	1.10	2.00
90	1.35	2.00
110	1.65	2.00
125	1.85	2.00
160	2.40	2.00
200	3.00	2.00
250	3.00	2.00

#### 2.0 Traps

##### 2.1 Floor Traps

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

##### 2.2 Urinal Traps

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

##### 2.3 Cleanout Plugs

Floor Clean Out and line clean out plugs

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

3.0 Drainage under floor/above floor (service floors, basement ceiling etc.)

3.1 All drainage lines passing under building, in exposed position above ground e.g. service floors, basement ceiling etc. shall be Multilayered as per details given in sub-clause 3.10 above or shall be as per details given below. Position of such pipes shall generally be shown on the drawings.

### 3.2 SOCKET PIPES

3 layer technology Polo-Eco Plus Premium 10 pipes and fittings for underground/misc. drainage applications having external layer of PP-Blend + mineral reinforcement, supporting layer of PP + magnesium silicate and internal in PP with chemical resistance between 2-13pH and ring rigidity of  $\geq 10\text{kN/m}^2$  having OFI certification for longitudinal stability & impermeability of pie connection in line with EN 14741.

### 3.3 FITTINGS

3-layered reinforced polypropylene (PP) sewage pipes, halogen and lead free, with integral push-fit socket and factory-fitted lip ring, tested and monitored according to the Product Standard EN 1852 – 1. Fittings upto dimension DN/OD 200 are manufactured by injection molding (1-layer), above DN/OD 200 (250 and above) the fittings are butt or extrusion welded by the manufacturer. Fabrication of fittings at site shall not be permitted.

### 3.4 Pipe Joints

Field-proven push-fit connection with improved and modified lip ring of high ageing-resistant shall be provided with the pipes and fittings for easy push-fit installation, installation procedure as given in clause 3.10 above shall be followed.

## 4.0 Air Admittance Valves (AAV)

Air admittance valves shall be made in ABS/PVC capable of operating at temperatures between 0 degree c and 60 degree c. The AAV shall be of suitable flow rate and installed in main discharge stacks and / or branches. Design based on air flow capacity required in proportion to the discharge unit capacities. The vendor is to supply data sheet showing relevant calculations and drawings indicating location and type of AAV as required.

AAV's to have following performance parameter:

- Temperature range: -20 degree Celsius to 60 degree Celsius.
- Open pressure: -70 pa (-0.010 psi)
- Max. Pressure rating tightness: 10,000 pa (1 m/40" h2o) at 0 pa or higher

## 5.0 SS GRATING

Floor gratings shall be hinged type cast/ sheet stainless steel with matching recessed rim. Each grating will be provided with a cockroach trap. Each floor drain shall be provided with a specially fabricated sheet metal stainless steel double anti-cockroach internal grating to prevent ingress of cockroaches inside the building.

### **SECTION-III: RAIN WATER PIPES & FITTINGS**

#### **RAIN WATER PIPES**

All open terraces shall be drained by rain water down takes.

Rainwater down takes are separate and independent of the soil and waste system and will discharge into the open ground Storm water Drainage system of the Complex.

Rain water in open courtyards shall be collected in catch basins and connected to the storm water drainage line.

#### **PVC Pipes & Fittings**

Pipes and fittings shall be uPVC. All pipes shall be straight and smooth as specified in Schedule of Quantities.

Pipes and fittings for main vertical stacks and branches 110 mm. & 160 mm. dia., shall be RainwaterSystem known in the short form as drainage system with injection moulded fittings and approved type of socket & 'O' rubber ring joints.

Joints shall be done as per the manufacturer's recommendations. The pipes and fittings must have matching dimensions for perfect joints in the system. 'O' ring fittings must have sufficient gap (approx. 10 mm.) for thermal expansion of pipes.

PVC pipes shall be clamped to the wall with approved type saddle clamps/U clamps and G.I. rod fixed to the angle iron support system within the shaft.

Use proper uPVC pipe adapters for connections between traps & uPVC pipes where necessary. Such joints shall be made of an approved type of 'Putty'.

#### **MEASUREMENT:**

Sanitary fixtures shall be measured by numbers.

Rates for all items mentioned above shall be inclusive of cutting holes and chases and making good the same, stainless steel screws, nuts, bolts and any fixing arrangements required and recommended by manufacturers, testing and commissioning.

Engineer/DFCCIL decision with respect to the correct interpretation regarding mode of measurement shall be final and binding on the contractor.

### **SECTION- IV: WATER SUPPLY SYSTEM**

#### **Scope of work**

Work under this section consists of furnishing all labour, materials equipment and appliances necessary and required to completely install the water supply system as required by the drawings, specified here-in -after and given in the Schedule of Quantities.

Without restricting to the generality of the foregoing, the water supply system shall include the following:-

Distribution system from main supply headers to all fixtures and appliances for cold & hot water.

Cold water supply lines from city water connections to Under Ground Water Tank.

Garden irrigation system

Excavation and refilling of pipes trenches.

Pipe protection and painting.

Control valves, masonry chambers and other appurtenances.

Connections to all plumbing fixtures, tanks, appliances and municipal mains

Inserts for R.C.C. tanks

#### General requirements

All materials shall be new of the best quality conforming to specifications. All works executed shall be to the satisfaction of the Architect/Engineer/DFCCIL.

Pipes and fittings shall be fixed truly vertical, horizontal or in slopes as required in a neat workman like manner.

Short or long bends shall be used on all main pipe lines as far as possible. Use of elbows shall be restricted for short connections.

Pipes shall be fixed in such a manner as to provide easy accessibility for repair and maintenance and shall not cause obstruction in shafts, passages etc.

Pipes shall be securely fixed to walls and ceilings by suitable clamps at intervals specified.

Clamps, hangers and supports on RCC walls, columns & slabs shall be fixed only by means of approved made of expandable metal fasteners inserted by use of power drills.

All pipe clamps, supports, nuts, bolts, washers shall be galvanised MS steel throughout the building. Painted MS clamps & MS nuts, bolts & washers shall not be accepted.

Valves and other appurtenances shall be so located as to provide easy accessibility for operations, maintenance and repairs.

#### Water Supply System

Contractor should study the site plan and the water supply systems including one for domestic water supply.

Source Water supply will be acquired from Municipal Corporation water mains (as available) to a service connection and collected in water storage tanks located underground.

The system has been connected to a gravity feed system from overhead tanks to all parts of the building

It is proposed to provide flushing cistern for all WCs. Infrared NO-TOUCH flush valves shall be provided for Urinals. These will be fed from overhead tank by gravity.

Domestic water supply shall be provided with cold water system only. Hot water provisions to kitchen and all toilets connected to a local electric hot water storage geyser other than add on solar system at terrace for inlet of geyser in kitchen etc.

#### **(CPVC) G.I. pipes & fittings**

All pipes inside the buildings for domestic hot and cold water supply shall be CPVC conforming to CTs SDR-13.5 at a working pressure of 320 PSI at 23 deg.C. and 80 PSI at 82 deg. C.

Solvent welded CPVC fittings etc. tees, elbows, couplers, unions, reducers, brushing etc. including transition fittings (connection between CPVC and metal pipes/G.I. ie. Brass adapters conforming to ASTM D-2846) shall be provided.

All pipes shall be fixed in accordance with layout and alignment shown on the drawings. Care shall be taken to avoid air pockets. G.I. pipes inside toilets shall run above false ceiling with vertical drop in wall chases for all fixtures. No pipes to run inside sunken floor as far as possible. Pipes may run under the ceiling or floors and other areas as shown on drawings.

#### **Joining Pipes & Fittings**

##### **Cutting**

Pipes shall be cut either with a wheel type plastic pipe cutting or hacksaw blade and care shall be taken to make a square cut. All burrs should be removed for proper contact between pipe and fittings during jointing.

##### **Solvent Cement Application**

Only CPVC solvent cement conforming to ASTM-F-493 should be used for joining pipe with fittings. An even coat of solvent cement should be applied on the pipe end and a thin coat inside the fitting socket.

##### **Assembly**

After applying the solvent cement on both pipe and fitting socket, pipe should be inserted into the fitting socket within 30 seconds, and rotating the pipe  $\frac{1}{4}$  to  $\frac{1}{2}$  turn while inserting so as to ensure even distribution of solvent cement with the joint. The assembled system should be held for 10 seconds (approximately) in order to allow the joint to set up.

##### **Testing**

The system should be hydrostatically pressure tested at 150 psi (10 Bar) for one hour. During pressure testing, the system should be fitted with water and if a leak is found, the joint should be cut out the replaced with new one.

##### **Transition of Flow guard CPVC in metals**

When making a transition connection to metal threads, special brass/plastic transition fitting (Male and female adapters) should be used. Plastic threaded connections should not be over torque.

#### Threaded sealants

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

#### Solvent Cement

Only CPVC solvent cement conforming to ASTM F 493 should be used for joining pipe with fittings and valves.

#### Hangers and supports

For horizontal runs, support should be given at 90 cm. intervals for diameters of 25mm. and below and at 1.2 m. intervals for larger sizes.

Supports should be as per the below mentioned table: (Change sizes into mm.)

Size of pipe	20°C	49°C	71°C	82°C
Inch (mm)	Ft. (mm)	Ft. (mm)	Ft. (mm)	Ft. (mm)
½" (15mm)	5.5 (420mm)	4.5 (340)	3.0 (230)	2.5 (190mm)
¾" (20mm)	5.5	5.0 (380)	3.0	2.5
1" (25mm)	6.0 (460mm)	5.5	3.5 (270)	3.0
1¼" (32mm)	6.5 (500mm)	6.0	3.5	3.5
1½" (40mm)	7.0 (530mm)	6.0	3.5	3.5
2" (50mm)	7.0	6.5	4.0 (305mm)	3.5

Please confirm above physical (mm) dimensions in practice

#### Anchor Fasteners

All pipe supports, hangers and clamps to be fixed on RCC walls, beams, columns, slabs and masonry walls 230mm. thick and above by means of galvanised expandable anchor fasteners in drilled holes of correct size and model to carry the weight of pipes. Drilling shall be made only by approved type of power drill as recommend and approved by manufacturer of the anchor fasteners. Failure of any fastening devices shall be the entire responsibility and contractor shall redo or provide additional supports at his own cost. He shall also compensate the DPL for any damage that may be caused by such failures.

### Unions

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

### Flanges

Flanged connections shall be provided on pipes as required or where shown on the drawings, all equipment connections as necessary and required or as directed by the Architect/Engineer/DFCCIL. Connections shall be made by correct number and size of GI nuts, bolts & washers with 3mm thick gasket. Where hot water connections are made insertion gasket shall be of suitable high temperature grade and quality approved by the Architect/Engineer/DFCCIL. Bolt hole dia. for flanges shall conform to match the specification for C.I. sluice valve and C.I. butterfly valve.

### Trenches

All water supply pipes below ground shall be laid in trenches with a minimum cover of 60 cms. The width and depth of the trenches shall be as follows:-

<b>Dia. of pipe</b>	<b>Width of trench</b>	<b>Depth of trench</b>
-----	-----	-----
15 mm to 50 mm	30 cm	75 cm
65 mm to 150 mm	45 cm	100 cm

### Sand filling

G.I. pipes in trenches shall be protected with fine sand 15 cms all round before filling in the trenches.  
Painting (Painting for CPVC pipes not required)

All pipes above ground shall be painted with one coat of red lead and two coats of synthetic enamel paint of approved shade and quality. Pipes shall be painted to standard colour code given in this document or specified by Architect/Engineer/DFCCIL.

### Pipe protection (Protection for CPVC pipes not required)

All G.I. pipes in wall chase /below floors or laid under-ground shall be protected against corrosion by the application of two coats of bitumen paint covered with polythene tape and a final coat of bitumen paint.

G.I. waste pipes buried in ground or sunken slab shall be protected with multilayer bitumen membrane tape 3mm thick with a final coat of hot or cold applied bitumen.



### **Ball Valves**

Valves upto 40 mm dia. shall be screwed type Ball Valves with stainless steel balls, spindle, teflon seating and gland packing tested to a hydraulic pressure of 20 kg/cm<sup>2</sup>, and accompanying couplings and steel handles.(to BS 5351)

### **Butterfly Valves**

Valves 50 mm dia and above shall be cast iron butterfly valve to be used for isolation. The valves shall be bubble tight, resilient seated suitable for flow in either direction and seal in both direction with accompanying flanges and steel handle.

### **Motorised Water Valve:**

The Motorized Water Valve shall consist of gunmetal valve body with stainless steel trim and equal percentage flow characteristics, modulating motor and linkage.

#### **Testing**

All pipes, fittings and valves after fixing at site, shall be tested by hydrostatic pressure of 1.5 times the working pressure or 10 kg/cm<sup>2</sup> whichever is more.

Pressure shall be maintained for a period of at least thirty minutes without any drop.

A test register shall be maintained and all entries shall be signed and dated by Contractor (s) and Engineer/DFCCIL.

In addition to the sectional testing carried out during the construction, Contractor shall test the entire installation after connections to the overhead tanks or pumping system or mains. He shall rectify all leakages and shall replace all defective materials in the system. Any damage done due to carelessness, open or burst pipes or failure of fittings, to the building, furniture and fixtures shall be made good by the Contractor during the defects liability period without any cost.

After commissioning of the water supply system, Contractor shall test each valve by closing and opening it a number of times to observe if it is working efficiently. Valves which do not effectively operate shall be replaced by new ones at no extra cost and the same shall be tested as above.

### **Measurement**

CPVC or G.I. pipes above ground shall be measured per linear meter (to the nearest cm) and shall be inclusive of all fittings e.g. coupling, tees, bends, elbows, unions, flanges and U clamps with nuts, bolts & washers fixed to wall or other standard supports.

Jointing with teflon tape, white lead and insertion gasket of appropriate temperature grade. Cutting holes, and chases in walls, floors, any pipe support required for pipes below ground & making good the same. Excavation, back filling, disposal of surplus earth and restoring the ground & floor in original condition.

Pipe Supports.

Fabricated and galvanised supports shall be measured by weight. Weight for each type of clamp shall be calculated on basis of the quantity of structural and MS used from the theoretical weight calculated on basis of the components theoretical weight of the sections.

Rate quoted for supports & hangers shall be inclusive of:-

Expandable anchor fastens.

Galvanising of all supports & hangers.

Cutting holes in walls, ceilings on floors and making good where permitted.

Nuts, bolts and washers for fixing and assembling.

Wooden/PVC pipe saddles for vertical or horizontal runs.

#### **5 LAYER TECHNOLOGY, having:**

- 1st layer of specially stabilized PP-r of UV protection.
- 2nd and 4th layer of HPCE glass fibre compound for greater stability and a 75% lower linear expansion as compared to single layer pipes.
- 3rd and 5th layer of PP-RCT provides high temperature stability and improved long term resistance.

AVAILABLE IN SIZES: 20MM TO 63MM.

**TECHNICAL SPECIFICATIONS FOR FIRE FIGHTING WORKS  
(SECTION-5)**

## **Section I          Hand Appliances**

### **1          Scope of work**

- 1.1 Work under this section shall consist of furnishing all labour, material, appliances and equipment necessary and required to install fire extinguishing hand appliances.
- 1.2 Without restricting to the generality of the foregoing the work shall consist of the following: -  
Installation of fully charged and tested fire extinguishing hand appliances CO2 foam, dry chemical powder type as required by these specifications and/drawings.

### **2          General requirements**

- 2.1 Fire extinguishers shall conform to the following Indian Standard Specifications and shall be with ISI approved stamp as revised and amended up to date:-
- 2.2 Fire extinguishers shall be installed as per Indian Standard "Code of Practice for Selection, Installation and Maintenance of Portable First Aid Appliances" I.S.2190-1962.
- 2.3 Hand appliances shall be installed in readily accessible locations with the appliance brackets fixed to wall by suitable anchor fasteners.
- 2.4 Each appliance shall be provided with an inspection card indicating the date of inspection, testing, change of charge and other relevant data.
- 2.5 All appliances shall be fixed in a true workmanlike manner truly vertical and at correct locations.

### **3          Measurement**

Fire extinguishers shall be measured by numbers and include installation and all items necessary and required and given in the specifications.

## **Section II          SPRINKLER SYSTEM**

### **1.          Sprinkler Heads**

Sprinkler heads shall be quartzoid bulb type with gunmetal body fully approved and having current certification of the fire laboratory of the C.B.R.I. Roorkee, Underwriter's laboratory (UL) and under the approved certified list of the Fire Office Committee (FOC) of U.K. or NFPA of USA. Any one of the certifications as acceptable to the local fire authorities obtained prior to the procurement and approved and accepted by the Architect/Engineer/DFCCIL.

Sprinkler heads shall be installed in conformity with approved shop drawings and in co-ordination with electrical fixtures, ventilation ducts, cable galleries and other services along the

ceiling. Following type of sprinklers shall be used:

S.No.	Type of Sprinkler	Temp rating
a)	Pendent /Upright type	68°C
b)	Sidewall	68°C

Spacing and coverage of sprinkler shall be in accordance with risk classification of area in which they are installed, design density and TAC regulation

#### **Annunciation Panel**

- Provide one solid state electronic annunciation panel, fully wired with visual display unit to indicate:
- Flow condition in any flow indicating valve
- The panel should give a visual and audible alarm for any of the above conditions.
- The panel should be standard manufacturer's factory made. All details shall be submitted with the tender.

#### **Testing**

All piping in the system shall be tested to a hydrostatic pressure of 1.5 times the working pressure or 14 kg/sq.cm (whichever is more) without drop in pressure for at-least 2 hours.

Rectify all leakages, make adjustments and retest as required and directed.

#### **Cables**

Contractor shall provide control cables from supervisory valves and switches to the annunciation panels.

All control cables shall be copper conductor PVC insulated armoured and PVC sheathed 1100-volt grade.

All cables shall have stranded conductors. The cables shall be in drums as far as possible and bear manufacturer's name.

All cable joints shall be made in an approved manner as per standard practice.

#### **Cable Trays**

All cables shall be routed in approved locations in coordination with all other services in a proper manner.

Cable trays shall be of galvanized steel and hung from the ceiling by galvanised rods supported by appropriate size and type of expandable expansion fasteners drilled into the slabs and walls by an electric drill.

## 2. **Flow Switch**

Flow switch shall have a paddle of suitable width to fit within the pipe bore. The terminal box shall be mounted over the paddle/ pipe through a connecting socket. The switch shall have potential free contact of suitable rating with N O or N C position as required. The switch shall be able to trip and make / break contact on the operation of a single sprinkler head. The terminal box shall have connections for wiring to the Annunciation panel. The seat shall be stainless steel. The flow switch enclosure shall have IP:65 protection.

The flow switch shall work at a minimum flow rate of 100 LPM. Further, it shall have a 'Retard' to compensate for line leakage or intermittent flows.

## 3. **Installation Valve**

Installation valves shall be installed on the sprinkler circuits as shown on the drawings.

Contractor shall submit his detailed shop drawings showing the exact location, details of installation of the valve and alarm in all its respects.

Installation valve shall comprise of a cast iron sluice valve with gunmetal trim, pressure gauge, double seated clapper check valves as alarm valve with pressure gauge, test valve and orifice assembly and drain pipe with pressure gauge, bye pass on check valve to regulate differential pressure and false alarm, turbine water gong including all accessories necessary and required and as supplied by original equipment manufacturer and required for full and satisfactory performance of the system.

## 4. **Measurement**

Mild steel pipes shall be measured in linear metres of the finished length correct upto one cm. and shall include all fittings, flanges, welding, jointing, clamps for fixing to walls or hangers, anchor fasteners, painting and testing complete in all respects.

Sluice and fullway valves, check valves, installation valves, air valves & flow switches shall be measured by numbers and shall include all items necessary and required for fixing and as given in the specifications and bill of quantities.

Fire hydrants, hose reels, fire brigade connections, orifice flanges shall be measured by number and include all items given in the specifications and bill of quantities.

Fire hose and boxes specified shall be measured by number and include all items given in specifications and Bill of Quantities.

Cables and cable trays shall be measured in linear metre correct upto cm shall include clamps, hangers, anchor fasteners complete in all respects.

## **Hand Appliances**

## 1 **Scope of work**

1.1 Work under this section shall consist of furnishing all labour, material, appliances and equipment necessary and required to install fire extinguishing hand appliances.

1.2 Without restricting to the generality of the foregoing the work shall consist of the following: -

Installation of fully charged and tested fire extinguishing hand appliances CO2 foam, dry chemical powder type as required by these specifications and/drawings.

## 2 **General requirements**

2.1 Fire extinguishers shall conform to the following Indian Standard Specifications and shall be with ISI approved stamp as revised and amended up to date.

2.2 Fire extinguishers shall be installed as per Indian Standard "Code of Practice for Selection, Installation and Maintenance of Portable First Aid Appliances" I.S.2190-1962.

2.3 Hand appliances shall be installed in readily accessible locations with the appliance brackets fixed to wall by suitable anchor fasteners.

2.4 Each appliance shall be provided with an inspection card indicating the date of inspection, testing, change of charge and other relevant data.

2.5 All appliances shall be fixed in a true workmanlike manner truly vertical and at correct locations.

## 3 **Measurement**

Fire extinguishers shall be measured by numbers and include installation and all items necessary and required and given in the specifications.

## **SPRINKLER SYSTEM**

### 1. **Sprinkler Heads**

Sprinkler heads shall be quartzoid bulb type with gunmetal body fully approved and having current certification of the fire laboratory of the C.B.R.I. Roorkee, Underwriter's laboratory (UL) and under the approved certified list of the Fire Office Committee (FOC) of U.K. or NFPA of USA. Any one of the certifications as acceptable to Architect/Engineer/DFCCIL.

Sprinkler heads shall be installed in conformity with approved shop drawings and in co-ordination with electrical fixtures, ventilation ducts, cable galleries and other services along the ceiling. Following type of sprinklers shall be used:

S.No.	Type of Sprinkler	Temp rating
a)	Pendent /Upright type	68°C

- b) Sidewall 68°C

Spacing and coverage of sprinkler shall be in accordance with risk classification of area in which they are installed, design density and TAC regulation

### **Spare Sprinklers**

Provide a lockable enamel painted steel cabinet including following type of spare sprinklers

- a) Pendent /Upright type 20  
b) Sidewall 10

The cabinet should also contain one pair of wrenches (of each size of the same are different) for the sprinklers.

Spare sprinklers shall be of the same specifications as that of the original sprinklers specified.

### **Annunciation Panel**

- a) Provide one solid state electronic annunciation panel, fully wired with visual display unit to indicate:  
b) Flow condition in any flow indicating valve  
c) The panel should give a visual and audible alarm for any of the above conditions.  
d) The panel should be standard manufacturer's factory made. All details shall be submitted with the tender.

### **Testing**

All piping in the system shall be tested to a hydrostatic pressure of 1.5 times the working pressure or 14 kg/sq.cm( whichever is more) without drop in pressure for at-least 2 hours.

Rectify all leakages, make adjustments and retest as required and directed.

### **Cables**

Contractor shall provide control cables from supervisory valves and switches to the annunciation panels.

All control cables shall be copper conductor PVC insulated armoured and PVC sheathed 1100 volt grade.

All cables shall have stranded conductors. The cables shall be in drums as far as possible and bear manufacturer's name.

All cable joints shall be made in an approved manner as per standard practice.

### **Cable Trays**

All cables shall be routed in approved locations in coordination with all other services in a proper manner.



Cable trays shall be of galvanized steel and hung from the ceiling by galvanised rods supported by appropriate size and type of expandable expansion fasteners drilled into the slabs and walls by an electric drill.

## **2. Flow Switch**

Flow switch shall have a paddle of suitable width to fit within the pipe bore. The terminal box shall be mounted over the paddle / pipe through a connecting socket. The switch shall have potential free contact of suitable rating with N O or N C position as required. The switch shall be able to trip and make / break contact on the operation of a single sprinkler head. The terminal box shall have connections for wiring to the Annunciation panel. The seat shall be stainless steel. The flow switch enclosure shall have IP:65 protection.

The flow switch shall work at a minimum flow rate of 100 LPM. Further, it shall have a 'Retard' to compensate for line leakage or intermittent flows.

## **3. Installation Valve**

Installation valves shall be installed on the sprinkler circuits as shown on the drawings.

Contractor shall submit his detailed shop drawings showing the exact location, details of installation of the valve and alarm in all its respects.

Installation valve shall comprise of a cast iron sluice valve with gunmetal trim, pressure gauge, double seated clapper check valves as alarm valve with pressure gauge, test valve and orifice assembly and drain pipe with pressure gauge, bye pass on check valve to regulate differential pressure and false alarm, turbine water gong including all accessories necessary and required and as supplied by original equipment manufacturer and required for full and satisfactory performance of the system.

## **4.Measurement**

Mild steel pipes shall be measured in linear metres of the finished length correct upto one cm.and shall include all fittings, flanges, welding, jointing, clamps for fixing to walls or hangers, anchor fasteners, painting and testing complete in all respects.

Sluice and fullway valves, check valves, installation valves, air valves & flow switches shall be measured by numbers and shall include all items necessary and required for fixing and as given in the specifications and bill of quantities.

Fire hydrants, hose reels, fire brigade connections, orifice flanges shall be measured by number and include all items given in the specifications and bill of quantities.

Fire hose and boxes specified shall be measured by number and include all items given in specifications and Bill of Quantities.

Cables and cable trays shall be measured in linear metre correct upto cm shall include clamps, hangers, anchor fasteners complete in all respects.

**TECHNICAL SPECIFICATION FOR  
HVAC WORKS  
(SECTION-6)**



## CONTENT OF TECHNICAL SPECIFICATION

1.0	SCOPE
1.1	Standards
1.2	Conformity to Statuary Acts
1.3	Safety Codes
1.4	System Requirements
1.5	Design Parameters
1.6	Drawings
1.7	Guarantee
2.0	VRV/VRF SYSTEM
2.1	Outdoor Units
2.2	Indoor Units
2.3	Refrigerant Piping & Insulation
2.4	Drain Piping & Insulation
2.5	Remote Controllers
2.6	Touch Screen Controllers
2.7	UVC
2.8	MESF Filter
2.9	REFNETS
3.0	AIR DISTRIBUTION SYSTEM
3.1	AHU
3.2	Duct & Insulation
3.3	Fresh/Exh. Louvers
3.4	Canvas
4.0	VENTILATION SYSTEM
4.1	Propeller Fan
4.2	In line Fans
4.3	Tube Axial Flow Fans
4.4	Air Washer
4.5	Air Scrubber
4.6	Air Curtains
5.0	ELECTRICAL WORK
5.1	Panels
5.2	Motors
5.3	Starters
5.4	LT Cables
5.5	Control Cables
6.0	PAC
7.0	INSPECTION, TESTING & COMMISSIONING
8.0	CAMC



## 1.0 GENERAL

### 1.1 SCOPE OF WORK

The Scope of Work covers the design, drawing submission, drawing approval, supply, installation, testing, commissioning, training, warranty and maintenance of HVAC system, BMS and services provided for the same. The HVAC system must be able to integrate seamlessly with BMS and provide all available data on Ethernet/BACnet or other open platform.

### 1.2 REFERENCES / STANDARDS:

- ❖ **National Building Code of India –2016**
- ❖ **HVAC Specifications from CPWD**
- ❖ **ANSI:** American National Standard institute (**Wherever applicable**)
- ❖ **BIS:** Bureau of Indian Standards (This code will supersede in case of any ambiguity or misinterpretation)
- ❖ **ASHRAE:** American Society of Heating Refrigeration and Air conditioning Engineers
- ❖ **ISHRAE:** Indian Society of Heating Refrigeration and Air conditioning Engineers
- ❖ **ASME:** American Society for Mechanical Engineers
- ❖ **SMACNA / BIS:** For Duct construction standards.

IS Number	Title
IS 196	Atmospheric conditions for testing
IS 325	Three phase induction motors
IS 8148	Packaged Air Conditioners
IS 2360	Voltage bands for electrical installations including preferred voltages and frequency
IS 3615	Glossary of Terms Used In Refrigeration And Air Conditioning
ISO 5151	Non- ducted air conditioners and heat pumps — Testing and rating for performance
ISO 15042	Multiple split system air- conditioners and air-to- air heat pumps — Testing and rating for performance
ISO 16358 – 1	Air cooled air conditioners and air-to-air heat pumps — Testing and calculating methods for seasonal performance factors — Part 1: Cooling seasonal performance factor
ISO 16358 – 2	Air-cooled air conditioners and air-to-air heat pumps — Testing and calculating methods for seasonal performance factors — Part 2: Heating seasonal performance factor
ISO 16358 – 3	Air-cooled air conditioners and air-to-air heat pumps —

	Testing and calculating methods for seasonal performance factors — Part 3: Annual performance factor
ISO 5149 – 1	Refrigerating systems and heat pumps – Safety and environmental requirements – Part 1: Definitions, classification and selection criteria
ISO 5149 – 2	Refrigerating systems and heat pumps – Safety and environmental requirements – Part 2: Design, construction, testing, marking and documentation
ISO 5149 – 3	Refrigerating systems and heat pumps – Safety and environmental requirements – Part 3: Installation site.
ISO 5149 – 4	Refrigerating systems and heat pumps – Safety and environmental requirements – Part 4: Operation, maintenance, repair and recovery
EN 14825	Air conditioners, liquid chilling packages and heat pumps with electrically driven compressors for space heating and cooling - Testing and rating at part load conditions
EN 145111 – 1	Air conditioners, liquid chilling packages and heat pumps with electrically driven compressors for space heating and cooling – Part 1: Terms, definitions and classification
EN 145111 – 2	Air conditioners, liquid chilling packages and heat pumps with electrically driven compressors for space heating and cooling - Part 2: Test conditions
EN 14511 – 3	Air conditioners, liquid chilling packages and heat pumps with electrically driven compressors for space heating and cooling - Part 3: Test methods
EN 14511 – 4	Air conditioners, liquid chilling packages and heat pumps with electrically driven compressors for space heating and cooling - Part 4: Operating requirements, marking and instructions
IS / ISO 817	Organic refrigerants – Number designation
ISO 3744	Acoustics -- Determination of sound power levels and sound energy levels of noise sources using sound pressure -- Engineering methods for an essentially free field over a reflecting plane
ISO 9614 – 1	Acoustics - Determination of Sound Power Levels of Noise Sources Using Sound Intensity - Part 1: Measurement at Discrete Points
ISO 9614 – 2	Acoustics - Determination of Sound Power Levels of Noise Sources Using Sound Intensity - Part 2: Measurement by Scanning
AHRI 1230	Performance Rating of Variable Refrigerant Flow (VRF) Multi-Split Air-Conditioning and Heat Pump Equipment

BS 4718 : 1971	Method of test of silencer for air distribution systems.
BS 2750: Parts 1-9:1980	Laboratory and field measurement of airborne sound insulation of various building element.
BS 3638 : 1987	Method of measurement of sound adsorption in a reverberation room.
BS 4773: Part 2: 1976	Acoustic performance without additional ducting of forced fan convection equipment.
BS 4954: Part 2: 1978(1987)	Acoustic testing and rating of induction units.
BS 5643:1984	Glossary of Refrigeration, Heating Ventilation and Air Conditioning terms

### 1.3 SUBMITTALS:

- a. Heat Load Calculation and Design of HVAC system for the area under consideration.
- b. Make and Sample approval of various items as per approved List of Make.
- c. Shop drawings.
- d. Any other as per requirement.

### 1.4 SHOP DRAWINGS

Submit a copy of the shop drawings, including:

- a. Actual duct routes after the site survey.
- b. Automatic temperature /Pressure control system.
- c. Inertia pads and foundations for the various equipments.
- d. Fire protection systems (Fire / Smoke dampers: Motorized) (Relief dampers, smoke extract system, pressurization system)
- e. Layout of the AHU/IDU / Plant room including dimensions of the room and the foundations and the sizes and all necessary construction details required on site.
- f. Location of the allied equipments and the requirements from other agencies.
- g. Trench locations if any.
- h. Sump location and size.
- i. Sleeve location if any.
- j. Ventilation air / exhaust air locations.
- k. Location of wall mounted equipment (If any)
- l. Any structural inputs.

**1.5 Brochures:**

- a. Submit manufacturer's product data and brochure including :
- b. Complete description.
- c. Illustrations.
- d. Rating data, accessories, dimensional data.
- e. Capacities stated in the terms specified.
- f. Performance curves of the fans and pumps.

**1.6 PROJECT/SITE CONDITIONS**

Mechanical layouts indicated on drawings are diagrammatical. Co-ordination (final) shall be required with other trades prior to installation. Install all works as shown on the drawings, unless prevented by project conditions.

Prepare drawings showing proposed rearrangement of work to meet the project conditions, obtain permission from Engineer before proceeding.

Place anchors, sleeves and supports prior to pouring concrete on installation of masonry works.

Keep roads and site clear of debris and scrap.

**1.7 DESIGN PARAMETERS****Air Handling Units**

Maximum face velocity across cooling coil	155 m/min
Maximum velocity across filters (Ordinary/Micro-vee)	155 m/min
Maximum outlet air velocity	610 m/min
Maximum fan speed for fans upto 300 mm dia	1450 RPM
Maximum fan speed for fans above 300 mm dia	1000 RPM

**Centrifugal Fans**

Maximum fan outlet velocity for fans upto 450 mm dia	550 m/min.
Maximum fan outlet velocity for fans above 450 mm dia	700 m/min
Maximum fan speed for fans upto 450 mm dia	1450 RPM
Maximum fan speed for fans above 450 mm dia	1000 RPM

**Duct Design**

	Main Duct	Branch Duct
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Maximum flow velocity	400 m/min	250 m/min
Maximum Velocity at supply air grills/diffusers	150 m/min	
Maximum friction in duct	1 cm WG/100 m run	

## 1.8 PAINTING AND SERVICE IDENTIFICATION

The scope of this section comprises of identification of service for each piece of equipment and allied works.

### Duct work service :

For duct work service and its insulation the colour of the triangles shall comply with **BS. 1710 : 1971**. the size of the symbol will depend on the size of duct and the viewing distance but the minimum size should not be less than **150 mm** length per side. One apex of the triangle shall point of the direction of air flow.

Service	Color	BS 4800 Color Reference
Conditioned air	Red and Blue	04 E 53/ 18 E 53
Ward air	Yellow	10 E 53
Ventilation air	Green	14 E 53
Exhaust / extract Recalculated air	Gray	AA 0 09
Foul air	Brown	06 C 39
Dual duct system hot Supply air	Red	04 E 53
Cold supply air	Blue	18 E 53

In addition to the color triangle specified above all duct work shall be legibly marked with black or white letter to indicate the top of service identified as follows:-

Supply air	S
Return air	R
Ventilation air	F
Exhaust air	E

The color banding and triangle shall be manufactured from self-adhesive cellulose tape laminated with a layer of transparent ethyl cellulose tape.

## 1.9 GOOD ENGINEERING PRACTICES FOR HVAC WORKS

- a. **Mechanical noise control:** All good engineering practices involved in controlling the noise of equipment within permissible limits shall be adopted by the contractor.
- b. **Vibration Control:** All good engineering practices involved in controlling the vibrations of equipment within permissible limits shall be adopted by the contractor.
- c. Equipment at the best operating parameters and acoustical performance alongwith the necessary isolation devices for vibration control shall be adopted by the manufacturer and the contractor.

**1.9.1 INTENT in general pertaining to this section is as follows:**

The vibration isolators for certain equipment have been specified and quantified in the BOQ, however, if any additional safeties are required to fulfill the intent of this basic mechanical requirement, then the same shall be provided by the manufacturer/contractor at no additional cost.

Mechanical service shall generally be designed and installed with provisions to contain noise and the transmission of vibration generated by moving plant and equipment schedules to achieve acceptable noise rating specified for occupied areas.

In addition to the provision specified in the specification, particulars attention must be given to the following detail at time of ordering plant and equipment and their installation:-

- a. All moving plant, machinery and apparatus be statically and dynamically balance at manufactures work and certificate issued.
- b. The isolation of moving plant. Machinery and apparatus including lines equipment from the building structure.
- c. Where duct work and pipe work service pass through walls floor and ceiling or where supported shall be surrounded with a resilient acoustic absorbing material to prevent contact with the structure and minimize the outbreak of noise from plant room.
- d. The reduction of noise breakout from plant room and the section of externally mounted equipment and plant to meet ambient noise level requirement of the specifications.
- e. Electrical conduits and connection to all moving plant and equipment shall be carried out in flexible conduit and cable to prevent the transmission of vibration to the structure and nullify the provision of anti-vibration mountings.
- f. All duct connection to fans shall incorporate flexible connections. Except in cases where these are fitted integral within air handing unit.
- g. All resilient acoustic absorbing materials shall be non flammable vermin and rot proof and

shall not tend to break up or compress sufficiently to transmit vibration or noise from the equipment to the structure.

- h. Where practicable silencer shall be built into walls and floor to prevent the flanking of noise the duct work system (If Any) and their penetrations sealed in the manner previously described.
- i. Where this is not feasible the exposed surface of the duct work between the silencer and the wall subjected to noise infiltration shall be acoustically clad as specified.

## **1.10 TENDER DRAWINGS, DRAWINGS FOR APPROVAL & COMPLETION DRAWINGS**

### **1.10.1 Tender Drawings**

The drawings appended/ uploaded with the tender documents are intended to show the areas to be conditioned, space allotted for various equipments, tentative duct, cable and pipe routes. The equipments offered shall be suitable for installation in the spaces shown in these drawings.

### **1.10.2 Drawings for approval on award of the work**

The contractor shall prepare & submit three sets of hard copy & one Digital/ soft copy in AutoCAD format of following drawings and get them approved from the Engineer-in-Charge before the start of the work. The approval of drawings however does not absolve the contractor not to supply the equipments/ materials as per contract, if there is any contradiction between the approved drawings and contract.

- a. Lay out drawings of the equipments to be installed in various rooms such as ODU, IDU, AHU rooms, ducts and other equipments.
- b. Drawings including section, showing the details of erection of entire equipments including their foundations, layout, etc.
- c. Ducting drawings showing sizes, locations of dampers, grilles & diffusers.
- d. Electrical wiring diagrams for all electrical equipments and controls including the sizes and capacities of the various cables and equipments,
- e. Dimensioned drawings of all electrical and control panels,
- f. Drawings showing the details of all insulations works,
- g. Drawings showing details of supports for pipes, cable trays, ducts etc.
- h. Any other drawings relevant to the work.

The contractor shall, use the soft copy of such drawings to prepare and examine the integrated services layout, resolve conflicts, and modify the execution drawings suiting & adjusting to all the services requirements. The contractor shall be bound to modify & execute accordingly.

### **1.10.3 Completion Drawings**

One set of Digital/ soft Copy and one set of the following laminated drawings shall be submitted by the contractor while handing over the installation to the DFCCIL. Out of this one of the sets

shall be laminated on a hard base for display in the control room. In addition one set will be given on compact disc.

- a. Plant installation drawings giving complete details of all the equipments, including their foundations,
- b. AHU room installation drawings,
- c. Duct layout drawings with their sizes and locations, and sizes and locations of all dampers, grills & diffusers,
- d. Line diagram and layout of all electrical control panels giving switchgear ratings and their disposition, cable feeder sizes and their layout,
- e. Control wiring drawings with all control components and sequence of operations to explain the operation of control circuits,
- f. BMS drawings

### **1.11 SAFETY CODES**

The following IS codes shall be followed in reference to the Safety:

Safety code for mechanical refrigeration	IS 660
Safety code for air conditioning	IS 659
Safety code for scaffolds & ladders	IS 3696
Code of practice for fire precaution in Welding & cutting operations	IS 3016
Code for safety procedures and practices In electrical works	IS 5216
Code of practice for safety and health Requirements in electrical & gas welding and cutting operations.	IS 3696

## 2.0 VARIABLE REFRIGERANT VOLUME/FLOW SYSTEM

### 2.1 SCOPE

The scope of this section comprises the supply, erection, testing and commissioning of Variable Refrigerant Flow System conforming to these specifications and in accordance with the requirements of Drawings and Schedule of quantities.

### 2.2 TYPE

Unit shall be air cooled heat pump type, variable refrigerant volume/flow air conditioner consisting of one outdoor unit and multiple indoor units. Each indoor unit shall have capability to cool or heat. The indoor units on any circuit can be of different type and also controlled individually. Compressor installed in each modular outdoor unit shall be equipped with 100% inverter Scroll compressors for higher reliability, improved life, better backup and duty cycling purpose. Outdoor unit shall be suitable for mix match connection of all type of indoor units and capable of connecting minimum ten different types of indoor units to one refrigerant circuit and controlled individually. The system shall be capable of changing the rotating speed of inverter compressor by inverter controller to follow variations in cooling and heating load.

The refrigerant piping between indoor units and outdoor unit shall be possible to extend up to a minimum of 165m with maximum 50m level difference without any oil traps.

Both indoor units and outdoor unit shall be factory assembled, tested and filled with first charge of refrigerant before delivering at site.

Following type of indoor units shall be connected to the system:

- ❖ Ceiling mounted ductable type.
- ❖ Ceiling mounted cassette type.
- ❖ Floor mounted ductable type
- ❖ Wall mounted Hi-Wall type.

Oil recovery system shall be managed without disturbance to normal operation cycle of the system / compressor.

In the piping work, minimal brazing shall be done.

The minimum COP shall be as specified in BOQ. Contractor shall furnish the following information:

Sr. No	Parameters of VRF system	COP data as per ISHRAE
1	COP at 100% Loading	
2	COP at 75% Loading	
3	COP at 50% Loading	
4	COP at 25% Loading	

Separate data is to be provided for different VRF models such as 16 HP, 24 HP etc.

The COP values as indicated are required to be furnished in Original by the tenderer directly from the original equipment Manufacturer (OEM).

### **2.3 OUTDOOR UNIT**

- a. The outdoor unit shall be factory assembled, weather proof casing, constructed from heavy gauge mild steel panels powder coated finish. The unit should be completely factory wired, tested with all necessary controls and filled with first charge of refrigerant before delivering at site.
- b. The outdoor unit shall have multiple inverter scroll compressors and be able to operate even in case of breakdown of one of compressors. The defective compressor can be bypassed on failure and rest ODU shall work with remaining compressor(s).
- c. The O/D units shall be capable to operate at ambient temperature range upto 49°C. The noise level shall not be more than 60 dB(A) at normal operation measured horizontally 1m away and 1.5m above ground.
- d. The outdoor unit shall be modular in design and shall be allowed for side by side installation.
- e. Each modular outdoor unit shall have multiple inverter Scroll type compressors with top throw. The compressors shall be designed and coordinated to achieve the highest efficiency. The unit shall be provided with its own microprocessor control panel. The outdoor units shall have anti-corrosion paint.
- f. The machine must have a sub cool feature to use coil surface more effectively thru proper circuit / bridge so that it prevents the flushing of refrigerant from long piping due to this effect thereby achieving energy savings. The unit shall provide at least 10 % higher heating capacity than cooling capacity at nominal conditions.
- g. The outdoor unit should be fitted with low noise aero spiral design fan with aero fitting grill for spiral discharge airflow to reduce pressure loss and should be fixed with DC/AC fan motor for better efficiency.
- h. The unit shall be designed in such as way that cleaning of drain Pan should be easy & inspection/ replacement of compressor should be easy.
- i. The outdoor unit shall have suitable cooling mechanism for better operation at high ambient temperature.
- j. The outdoor unit shall have feature to change the evaporative temperature with respect to load for better comfort.
- k. The systems shall have free phase technology & operation shall be continuous in case of phase reverse in supply electricity.
- l. The system shall have automatic refrigerant charge function for optimal charging of additional refrigerant.
- m. The fan static pressure of the outdoor unit shall be minimum 60-75 Pa to avoid hot air

recirculation.

- n. The compressors, inverters and all electronics in outdoor units must withstand reliable operation in high ambient temperatures. The units must operate reliably without any safety device tripping.
- o. The Outdoor machines shall be preferably compact machines for purpose of space saving and smaller foot print shall be preferred.
- p. The outdoor unit control shall possess following features:
  - The controls must ensure duty rotation between connected outdoor units for run time equalization.
  - In case of multiple compressors in an outdoor unit, the electronics must have an algorithm to rotate the compressor cycling for run time equalization.
  - All necessary safety devices shall be provided to ensure safe operation of the system. Following safety devices shall be part of outdoor unit: High pressure switch, High Discharge Gas temperature switch, Fan motor overload protection, Inverter drive overload protection, Inverter Temperature monitoring and safety cut off, Over load protection for compressor motor.

### **2.3.1 COMPRESSOR**

- a. The compressor shall be inverter type Scroll based control or Twin Rotary. The inverter shall be IGBT (insulated gate bipolar transistor) type for efficient and quiet operation. The inverter compressor shall change the speed in accordance to the variation in cooling or heating load requirement.
- b. All outdoor units shall have multiple steps of capacity control from 15%-100% to meet load variations / fluctuation and indoor unit individual control.
- c. PCB Chamber of outdoor unit should be refrigerant cooled.
- d. All parts of compressor shall be sufficiently lubricated stock.
- e. Forced lubrication may also be employed.
- f. Oil heater shall be provided in the compressor casing.

### **2.3.2 HEAT EXCHANGER**

- a. The Heat Exchanger shall be constructed with copper tubes mechanically bonded to aluminium fins to form a cross fin coil and larger surface area.
- b. The aluminum fins shall be covered by anti-corrosion resin film. The treatment shall be suitable for areas of high pollution, moisture and salt laden air. The condensing coils shall also have anti corrosion treatment.
- c. The casings, fans, motors etc. shall also be with anticorrosion treatment as a standard features.
- d. The unit shall be provided with necessary number of direct driven low noise level propeller type fans arranged for vertical / horizontal discharge. Each fan shall have a safety guard.
- e. The heat exchanger shall be made out of seamless copper tubes and have continuous aluminum fins. The fins shall be spaced by extruded collars forming an integral part of fins. The tubes shall be staggered in the direction of airflow. The tubes shall be mechanically expanded for thermal bonding with fins. Each coil shall be factory tested for leaks using dry nitrogen at a pressure at least 1.5 times the maximum working pressure.

### **2.3.3 REFRIGERANT CIRCUIT**

- a. The refrigerant circuit shall include liquid and gas shut-off valves and a solenoid valves at condenser end.
- b. The equipment must have inbuilt refrigerant stabilization control for proper refrigerant distribution.
- c. All necessary safety devices shall be provided to ensure the safe operation of the system.
- d. The system should be able to generate an alarm in case of refrigerant leak.
- e. Unit shall be equipped with an oil recovery and oil management system to ensure reliable operation of the system for its useful life.

### **2.3.4 SAFETY DEVICES**

All necessary safety devices shall be provided to ensure safe operation of the system. Whatever safety devices are required shall be part of the outdoor unit:

- High pressure switch,
- Low pressure switch,
- Fuse,
- Crankcase heater,
- Fusible plug,
- Fan drive overload protector,
- Over load relay,
- Over current protection for inverter, and
- Short recycling guard timer.

### **2.3.5 OIL RECOVERY SYSTEM**

- a. Unit shall be equipped with an oil recovery system to ensure stable operation with long refrigeration piping lengths. The system shall have oil recovery cycle of 8 or more hours.
- b. The system must be provided with oil balancing circuit to avoid poor lubrication.
- c. The outdoor unit must include an oil recovery device to limit the oil flowing with refrigerant to the indoor units. The device shall separate oil from compressor discharge gas and return it back to compressor
- d. The system should have inbuilt oil balancing circuit to avoid poor lubrication.

## **2.4 INDOOR UNITS**

- a. The type, capacity and size of indoor units shall be as specified in detailed Bill of Quantities. Indoor units shall be either ceiling mounted cassette type, or ceiling mounted ductable type or floor standing type or wall mounted type or any other type. Units shall be factory assembled, wired, piped and tested.
- b. Each unit shall have electronic control valve to control refrigerant flow rate in response to load variations of the room. The fan shall have highly efficient BLDC (Brushless Direct Current)



motor and statically and dynamically balanced direct driven DIDW multi-blade type blowers to ensure low noise and vibration free operation. The fan motors shall be thermally protected.

- c. The system should be designed such that in case of failure/trip of one indoor unit, the working of ODU and other indoor units should not be affected.
- d. Grills shall have auto swing feature for proper Air distribution.
- e. Units shall have DX coils made out of seamless copper tubes and have continuous aluminum fins. The fins shall be spaced by collars forming an integral part. The tubes shall be staggered in the direction of airflow. The tubes shall be hydraulically/ mechanically expanded for minimum thermal contact resistance with fins. Each coils shall be factory tested at 21kg/sqm air pressure under water. Anticorrosion treatment shall be provided for avoiding corrosion of coils.
- f. Unit shall have cleanable type filter fixed to an integrally moulded plastic /aluminium frame. The filter shall be easily serviceable.
- g. Each indoor unit shall have computerized control for maintaining design room temperature. Each unit shall be provided with microprocessor thermostat for cooling and heating.
- h. Each unit shall be with wired/Remote LCD type remote controller (as per BOQ). The remote controller shall memorize the latest malfunction code for easy maintenance. The controller shall have self-diagnostic features for easy and quick maintenance and service. The controller shall be able to change fan speed and angle of swing flap individually as per requirement.
- i. Concealed indoor units shall have sensor mounted on supply air grilles / diffusers which can be controlled with wireless remotes.
- j. All units shall have adequate insulation or Lining to avoid condensation.
- k. All interconnecting Copper piping, joints, U bends and Aluminum fins within the condensing/ evaporator unit shall be coated with two component, polysiloxane based coating with dry film thickness of about 25-35 microns on Cu and Upto 5 microns on Al fins. The coating shall be strong, flexible and durable. It shall have good adhesion and abrasion resistance. It shall be resistant to moisture, UV, acid - alkali and other chemicals. The coating shall be applied using air assisted Spray gun or brush.
- l. The indoor unit shall have a printed circuit board complete with address switches for a variety of operation controls, emergency operation switch and fault/ operation indication LEDs. The address of the indoor unit shall be set automatically in case of individual and group control.

#### **2.4.1 CEILING MOUNTED DUCTABLE TYPE UNIT**

Unit shall be suitable for ceiling mounted type. The unit shall include pre-filter, fan section & DX-coil section. The housing of unit shall be light weight powder coated galvanized steel. The unit shall have high static fan for ductable arrangement.

## **2.4.2 HIGH WALL MOUNTED UNITS**

The units shall be high wall mounted type. The unit shall include pre-filter, fan section & DX coil section. The housing of unit shall be light weight powder coated galvanized steel.

## **2.4.3 CEILING MOUNTED CASSETTE TYPE UNIT (MULTI FLOW TYPE)**

The unit shall be ceiling mounted type. The unit shall include pre-filter, fan section and DX coil section. The housing of the unit shall be powder coated galvanized steel. The body shall be light in weight and shall be possible to suspend from four corners. The cassette type unit having some parts in non-metallc construction must be UL-94-V0 certified.

The fan shall be aerodynamically designed diffuser turbo fan type. Unit shall have an external attractive panel for supply and return air. Unit shall have four way supply air grilles on sides and return air grille in center. Each unit shall have high lift drain pump, fresh air intake provision, low gas level detection system and very low operating sound. All the indoor units regardless of their difference in capacity should have same decorative panel size for harmonious aesthetic point of view.

## **2.5 REFRIGERANT PIPING**

- a) All interconnecting pipe-work between the condensing unit & indoor units shall have quality seamless copper tubes with brazed connections and the appropriate distribution joints and headers shall be used. The piping should be routed at site in such a manner, that brazed joints in the Refrigeration Piping are kept to a minimum.
- b) All Copper Pipes must be coated with polysiloxane based coating for better anti corrosion coating properties.
- c) The Refrigerant pipe work shall be insulated with XLPE Class-O tubular insulation/ Class-O closed cell elastometric Nitrile rubber tubular sleeves sections to avoid condensation and shall have low thermal conductivity, high mechanical strength, non-combustible, resistance to Fungi, ozone, UV and any other environmental pollutant. Moulded tee joints of thermal insulating material shall be used at bends y-joints etc. Test certificate for the same shall be submitted.
- d) To protect nitrile rubber/XLPE insulation of exposed copper piping from degrading due to ultra violet rays & atmospheric condition, it shall be covered with polyshield coating with at least two coats of resin and hardener above nitrile rubber/XLPE insulation. Fiberglass tape shall be helically wound & coated with two coats of resin with hardener to give smooth & plain finish.
- e) The refrigerant piping shall be extendable up to minimum 165 m with 50 m level without any oil trap. Distribution refrigeration pipe joints and headers shall be installed in an appropriate orientation to enable correct distribution of refrigerant. The Distribution joints shall be factory/site insulated. All pipe-work must be kept clean and free from contamination to prevent breakdown of the system. All pipe ends shall be kept sealed until immediately prior to making a joint.

- f) All joints in copper piping shall be sweat joints using low temperature brazing and or silver solder. For Copper to Copper joints, 15% Ag brazing rod shall be used. For Copper to other metal joints, 45% Ag brazing rod shall be used. Before jointing any copper pipe or fittings, its interiors shall be thoroughly cleaned by passing a clean cloth via wire or cable through its entire length. The piping shall be continuously kept clean of dirt etc. while constructing the joints. Subsequently, it shall be thoroughly blown out using nitrogen.
  - g) All refrigerant pipes shall be properly supported and anchored to the building structure using steel hangers, anchors, brackets and supports which shall be fixed to the building structure by means of inserts or expansion shields of adequate size and number to support the load imposed thereon.
  - h) Refrigerant charge must be calculated based on the actual length of the refrigerant pipe work. The refrigerant charging process must be carried out with an appropriate charging station and under supervision of manufacturer or his representative.
  - i) The insulated refrigerant piping and control wiring (in conduit) shall run on GI tray properly supported by GI rods. The exposed tray shall be covered by openable GI covers.
  - j) Bend of copper piping shall be done by proper mechanical bending machine.
  - k) The copper tubes shall be of two types: Soft drawn and Hard drawn as specified in BOQ. The chemical composition will confirm to grade C12200 designated as "Phosphorus Deoxidized High Residual Copper" grade having minimum Copper % of 99.9 % with Phosphorus % of 0.015 to 0.040%. The Mechanical properties should also be as per ASTM B280. Test certificate for the same shall be submitted.
  - l) The OD and wall thickness of the refrigerant piping should be as specified in BOQ. Minor variation as per recommendation of OEM may be allowed. The air-conditioning system supplier shall design piping sizes and erect proper interconnections of the complete refrigerant circuit.
  - m) The copper tubes shall be supplied with end Caps at both ends.
  - n) The copper tubes must be packed & sealed in polyethylene bags to protect them from any atmospheric degradation/contamination.
  - o) All copper tubes shall be 100% eddy current tested.
  - p) All the Tubes shall be RoHS (Restriction of Hazardous Substances) Complaint and each lot of supply shall be provided with routine test certificate.
- Testing Max. Permissible Content Limit (PPM)**
- |              |         |
|--------------|---------|
| Cadmium (Cd) | 100ppm  |
| Lead (Pb)    | 1000ppm |
| Mercury (Hg) | 1000ppm |
| Chromium     | 1000ppm |
- q) Each lot of copper tubes shall be inspected physically for any physical defects and the sizes shall be checked as per specification.
  - r) All connections, tees, reducers etc. shall be standard make fittings. The whole of the liquid and suction refrigerant lines including all fittings, valves and strainer bodies, etc. shall be insulated with 19mm /13 mm thick elastomeric nitrile rubber Class-O insulation. For individual Piping 50 / 100 mm wide Aluminium Tape shall be used at joints of Piping with Bands for identification.

- s) After the refrigerant piping installation has been completed, the refrigerant piping system shall be pressure tested using nitrogen at pressure of 38Kg per sq. cm. Pressure shall be maintained in the system for 24 hours. The system shall then be evacuated to minimum vacuum of 700mm hg and held for 24 hours.

## **2.6 UPVC DRAIN WATER PIPE**

Providing and fixing in position UPVC drain plumbing pipes of APPROVED Make or equivalent as per ASTM D-1785 (SCH-80) including cost of Specials as per ASTM D-2466 (SCH-80) including jointing with approved solvent cement, chase, cutting holes in walls roofs or floors etc. and making good to its original condition complete as per manufacturer's specifications and satisfaction of Engineer In-charge.

The condensate drain pipe connection of each fan coil unit to the main header should be rigid PVC pipe of heavy gauge with 25 mm dia /32mm dia as required. The header pipe should be of 50 mm dia/32 mm dia as required. The drain piping should be insulated with 9 mm thick tubular nitrile rubber insulation. For proper drainage of condensate U trap shall be provided in the drain piping wherever required. All pipe supports shall be prefabricated and pre-painted slotted angle supports, properly installed with clamps. The condensate drain pipe arrangement for disposal of condensate water be made in such a way that there should not be any leakages of condensate water inside rooms as well in the route of drain water pipe line & water should be discharged at the location jointly decided with Engineer-in-Charge of work.

All associated Civil Engineering works as per requirement at site in above connection like making chase in the wall & restoring it original shape by re-plastering & repainting, etc. are included in the scope of work. The arrangement of drain- pipe shall be made in such a way that it should not affect the aesthetic of the building as well as is maintenance friendly & easily accessible.

## **2.7 CENTRAL REMOTE CONTROLLER**

A multi-functional compact centralized controller (central remote controller) shall be supplied with the system. The System Controller shall provide proven air conditioning management system to give complete control of VRF Air Conditioning equipment. It should be user friendly. It shall be able to control minimum no of indoor units specified in BOQ.

The Centralized Remote Controller shall perform the following minimum functions.

- a. Starting/stopping of Air-conditioners as a zone or group or individual unit.
- b. Temperature setting for each zone, or group, or indoor unit.
- c. Switching between temperature control modes, switching of fans speed and direction of airflow.
- d. The address of the indoor unit shall be set automatically in case of individual and group control.

- e. Monitoring of operations status such as operation mode and temperature setting of individual indoor units, maintenance information, trouble shooting information.
- f. Scheduling of both indoor and outdoor units as per the requirement.
- g. Indication of operating condition.
- h. Select ON of all operation modes for each zone.
- i. The controller shall have user friendly color LCD Touch screen display. The centralized remote controller should be able to control the indoor units with control wiring upto a total distance of 1 KM.
- j. In case of power fluctuation or power failure, the addressing and other settings such as temperature of individual indoor units should not be affected. Alpha-numeric addressing of each indoor unit should be possible to facilitate the location of individual indoor unit.
- k. The controller shall be integrated to BMS system through software for monitoring & controlling of all above parameters including start/ stop of each indoor / outdoor unit. All necessary interface cards / units should be supplied as a part of the system to integrate to the BMS Software.

## **2.10 UVGI SOLUTION**

- a. UVGI Solutions shall be modular in design with modules rated 1000 and 2000 CFM which interconnect with each other. CFM capacity may vary depending upon the manufacturer to suit the HVAC requirements.
- b. UVC lamps shall comply with UL/CE compliant standard as applicable to usage of UVGI Solutions in HVAC equipments.
- c. Fixtures shall be manufactured in ISO 9001:2000 registered facility.
- d. Independent certified testing shall indicate that when emitter first installed total output per one inch length shall not be less than 9 micro W/cm<sup>2</sup> at one meter in 400 fpm (122 meter/min) air stream of 10<sup>0</sup> C and the end of manufacture tube warranty period or 9000 hours, whichever is longer.
- e. Initial UVC intensity on the coil face shall not be less than 1,200 micro W/cm<sup>2</sup> and at the end of life intensity on extreme corners of the coil face must exceed 750 micro W/cm<sup>2</sup>.
- f. The coil shall be substantially free of mold at the end of the manufacturer's emitter warranty period or 9000 hours, whichever is longer.
- g. Units shall be high output HVAC type germicidal UVC light source, factory assembled and tested. Components shall include a housing, reflector, high efficiency electronic power source, emitter sockets and emitter tube, all constructed to withstand HVAC environments.
- h. Single/Double ended unit housing shall be made of 304 stainless steel with DE units having electrical connectors on both ends to simplify gang wiring and wiring to power. They shall include mounting holes to assist in securing the fixture.

- i. DE reflectors shall be constructed of high spectral finished aluminium alloy with a minimum 85% reflectance of 254 nm UVC energy.
- j. High efficiency electronic power supplies shall be a class P2 with a power factor greater than 0.90 and a power conversion of greater than 90%. The power supply design shall include RF and EMI suppression. The power supply shall be designed to maximize photon production, irradiance and reliability in cold air stream of 0-140°F, 100% RH. The power supply shall be available in 110-270V, 50 Hz, single phase. Power source shall be UL/CE listed.
- k. UVGI Solution germicidal lamp tube shall be a hot cathode that produces UVC at 253.7 nm and no ozone or other secondary contaminants. The UVGI Solution germicidal lamp shall be tested by an independent test laboratory to provide UVC of 253.7 nm output per one inch of length of no less than 9 micro W/cm<sup>2</sup> at 1 meter in a 400 fpm (122 meter/min) air stream of 50oF (10°C). The UVGI Solution lamp shall be designed to maximize photon productions, irradiation and reliability in cold or moving air stream of upto 2000 fpm and temperatures of 35-140oF (2-60°C) and 100% RH. UVGI Solutions shall produce no ozone or other secondary contaminants.

#### **2.10.1 Installation of UVGI Solution**

- a. Coordinate with installation of HVAC equipment and install UVGI system as indicated after such equipment is properly installed.
- b. Provide an interlock switch on the access to the UVGI Solutions to turn the lights off when the access is opened.
- c. Install provided Caution Labels on all accesses to the UVGI.
- d. Irradiation – Emitters and fixtures are to be installed in sufficient quantity and in such an arrangement so as to provide an equal distribution of UVC energy on the coil and in the drain pan. To maintain energy efficiency, the UVC energy produced shall be of the lowest possible reflected and shadowed losses.
- e. To effectively irradiate the cooling coil surface and maximize the UVGI irradiation onto the coil, each UVGI lamp will be mounted on a dish antenna shaped parabolic reflector made of of anodized aluminum with high spectral reflectivity. This ensures maximum efficiency and focuses all the UV energy onto the coil. It also ensures that stray UVC intensity is leaked onto surfaces and parts located behind the UVGI lamps, which can result in rapid degradation of the fan blower belts and other plastic/rubber parts.
- f. The UVC make being offered shall have power consumption equal to or below 3.0 + 10% watt per inch of UVGI Solution length.

#### **2.11 REFNET Joint (Y Branch Fitting)**

VRF system shall not allow the use of a standard refrigeration T joints. The VRF system shall use specialty fitting that is called a Refnet or Y-Branch Fitting (terminology depends on

manufacturer). In addition to the specialty fitting itself each manufacturer has specific piping requirements for this fitting that must be adhered to for proper system function. In view of this, REFNET joints along with insulation shall be supplied by OEM only.

Use of the particular branch fitting (Refnet) appropriate to each individual unit type not only permits the pipes to be laid with ease but also increases the reliability of the system as a whole.

Units can be added by connecting them directly to the REFNET header or REFNET joint. Further branches cannot be included in the system below the REFNET header branch.

Special purpose REFNET pipe components must be used for all the pipe work. For reliable and efficient system, selection of components shall be made from REFNET and Piping Selection Rules of the OEM.

REFNET kits shall be supplied with insulation intended to fit over the main body of the REFNET joint after installation of the REFNET kit is complete.

### **3 AIR DISTRIBUTION SYSTEM**

#### **3.1 EUROVENT CERTIFIED DOUBLE SKIN AIR HANDLING UNITS**

##### **3.1.1 SCOPE**

The scope of this section comprises the supply, erection, testing and commissioning of double skin construction factory assembled air handling units, conforming of these specifications and in accordance with requirements of Drawings & of the Schedule of Quantities.

Unit performance, coil performance and Mechanical Characteristics shall be EUROVENT certified.

The unit & its components should conform to following standards

EN 1886	Air handling unit mechanical performance.
EN 13053	Ratings and performance for units and components.
EN 308	Test procedure for heat exchangers.
EN 779	Particulate air filters for general ventilation.
EN 1751	Aerodynamic testing of dampers.
EN 60204.1	Electrical equipment of machines.
EN ISO 3741	Determination of sound power level in reverberation rooms.
AMCA 210	Aerodynamic performance testing of fans.
AMCA 300	Reverberant room method of sound level testing
ISO 1940	Static & dynamic balancing for fans.

Minimum acceptable parameters according to above standards shall comply with the following:

#### **A) Mechanical Characteristics :**

##### **a) Casing Strength Classification : D1**

The casings to withstand the maximum fan pressure at the selected design fan speed. The maximum relative deflection should not exceed 4 mm/m. No permanent deformation of the structural parts (structures and supports) or damage of the casing may occur.

b) Casing Air Leakage : L1

Air leakage of the air handling unit should be tested under positive & negative pressure & should not exceed the values given below

Max. Air leak rate at - 400 Pa test pressure	:	0.15 l/sqm
Max. Air leak rate at +700 Pa test pressure	:	0.22 l/sqm

c) Filter Bypass Leakage : F9

The maximum allowable filter bypass leakage rate shall be 0.5% of design flow rate at 400 Pa positive test pressure.

d) Thermal Transmittance : T2

The unit should be designed to have a heat transfer coefficient given below

Heat transfer coefficient U :  $0.5 < U < 1.0 \text{ W/sqm.K}$

The test should be conducted in an environment chamber of Eurovent accredited laboratory & the readings should be taken after the steady state temperature difference of 20 K is established.

e) Thermal Bridging Factor : TB2

The unit should be designed to have a thermal bridging factor as given below.

Thermal bridging factor kb :  $0.6 < kb < 0.75$

The lowest difference of temperature at any point on the external surface and the mean internal temperature shall be established. The ration between the lowest temperature difference and the mean air to air temperature difference defines the thermal bridging factor.

The test should be conducted in an environment chamber of Eurovent accredited laboratory and the readings should be taken after the steady state temperature difference of 20 K is established.

B) Air Handling Unit Performance as per EN 13053

The performance of air handling units should be tested in a Eurovent accredited laboratory in accordance with EN 13053.

The tests would be carried out for

- Air flow – static pressure data - power consumption



- Heat recovery
- Cooling duty
- Heating duty
- Air – side & water - side pressure drop

### 3.1.2 TYPE

The air handling units shall be double skin construction, draw / blow - thru type comprising of various sections such as mixing box (wherever the Return air & Fresh Air are ducted) filter section, chilled water coil and hot water coil section, humidification section, fan section, fine filter plenum fabricated (wherever required ) as per details given in Drawings and Schedule of Quantity.

All the components of Air Handling unit should be supplied by AHU manufacturer.

### 3.1.3 CAPACITY

The air flow rate, static pressure, motor rating, cooling /heating capacity (TR/KW) shall be as shown on Air Flow Drawing and in Schedule of Quantity.

#### A. CASING

The casing of the air handling unit shall be of double skin construction, complying with Eurovent standard for mechanical characteristics as per EN 1886. The structure shall be made of Extruded Aluminium sections with polyamide thermal break profile for ensuring thermal bridging performance. The polyamide strip should be crimped to extruded aluminium sections for leak proof fitment. The structure shall be assembled using die cast Glass filled Nylon joints to make a sturdy, strong & self-supporting frame work for various sections. The profile shall have built in coved aluminium profile having smooth curvature from inside to avoid dust accumulation.

Double Skin Panels shall be minimum 50 mm thick constructed as follows:

- Outer skin  
Pre painted Galvanised Sheet Steel of 0.8 mm thickness with PVC guard film.
- Inner skin  
Aluzinc Sheet of 0.8 mm thickness.

The outer and inner skin shall be sandwiched with self-extinguishing CFC – HFC free PUF/ PIR insulation (density 38 +2 kg/m<sup>3</sup> with K factor not exceeding 0.02 Watt/m<sup>2</sup>) / Rockwool insulation (density not less than 96 kg/m<sup>3</sup>). The panels shall be screwed to the structure using soft food grade gasket to make it leak proof. Air tight access doors/panels with die cast zinc hinges shall be provided for access to various sections for maintenance.

The door shall be fitted with double wall inspection window of 200 mm diameter and robust glass filled nylon handles operational from both sides with optional locking arrangement. Each section should have inspection doors with duly wired marine lights and on/off switch mounted on wall of the unit. The entire housing shall be mounted on GSS channel frame work with provision for handling the units at site.

Drain Pan shall be constructed of 18 G 304 Stainless Steel with dual slope to facilitate immediate discharge of condensate. Specially designed drain pan with all round edges allow complete cleaning & avoid microbial growth as per ASHARE 62- 1999 standard. The drain tray will be insulated externally with 19 mm nitrile rubber & extended at least 300 mm beyond the coil. Necessary arrangement will be provided to slide the coil in the drain pan.

Mechanical performance of AHU casing shall be tested in Eurovent accredited laboratory as per EN1886 and should meet the following characteristics

Mechanical Strength : D1

Thermal Bridging : TB2

Thermal Transmittance : T2

Air Leakage : L1

Filter bypass leakage : F9

The air leakage thru the AHU casing shall not exceed the specified limits while tested as per class B of DW 143 standard.

## **B. PLUG FAN WITH EC MOTOR**

The complete EC Fan unit shall be of rugged bolted construction made of sheet steel, statically and dynamically balanced.

Fan: The fan section shall be equipped with a Single Inlet Centrifugal Impeller with High Efficiency Backward curved blades and external rotor EC (Electronically Commutated) motor, energy optimized for operation without spiral housing for high efficiency and favourable acoustic behaviour. The high efficiency backward curved impeller with rotating diffuser, made of high performance composite material / welded aluminium sheet material, with external rotor motor balanced together statically and dynamically according to DIN ISO 1940 Part 1.

The EC fan should be capable of being fitted in horizontal or vertical position in the AHU, depending on the application. Inlet cone shall be provided with a nozzle for volume flow measurement of the fan.

Motor: the motor shall be permanent magnet external rotor motor with integrated electronics and suitable for continuous operation. The speed of the motor shall be variable depending on an external control signal. The fans shall be Modbus RTU compatible for communication with BMS (Building Management System). The fan in totality shall be of most efficient type so that the power consumption and noise level is minimal. The EC motor shall have a wide voltage input range: 3~380...480V, 50/60 Hz. The motor shall be minimum IP55 protection class, with Thermal class 155 (Insulation class F). The EC motor shall be provided with suitable protection from moisture & hot climate. The ball bearing shall be provided with long time lubrication for maintenance free operation.

Integrated Electronics: The device electronics shall be protected from overload by the Active Temperature Management, so that if the ambient operating temperature exceeds the design limit then the fan is not switched off immediately. In such a condition the fan should be operational at lower speeds, till the time the operating ambient temperature drops down.

The EC motor shall meet all necessary EMC (Electromagnetic Compatibility) directives. The EC

motor should comply to applicable EMC standards: Interference Emission Standard EN 61000-6-3 / 2. EC Motor shall be Integrated with VSD (Variable Speed Drive) for speed modulation of fans.

Fan characteristic curves shall be related to measurements on a fan test rig with inlet silencing chamber in accordance with DIN 24163 Part 2 OR ISO 5801.

The performance data of the fan shall correspond to precision class 2 as defined by DIN 24166.

The EC motor shall have the following protective features integrated in the controller:

- Overvoltage protection
- Short Circuit protection
- Under voltage/ Over voltage detection
- Locked rotor protection
- Line fault detection
- Active Temperature Management for thermal protection of motor and electronics
- Alarm relay 250V/2A
- Over temperature protection of electronic and motor
- External LED display shall be provided for indication of the status of the fan

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#### **C. COOLING/HEATING COILS**

Chilled/hot water coil shall have 12.7 mm dia tubes minimum 0.4 mm thick with 0.15 mm thick waffle/ripple aluminium fins firmly bonded to copper tubes assembled in zinc coated steel frame.

Face & surface areas shall be such as to ensure rated capacity from each unit & such that air velocity across each coil shall not exceed 150 meters per minute.

The coil shall be pitched in the unit casing for proper drainage. Each coil shall be factory tested at 21 Kg per sq.cm (300 psig) air pressure under water. Tube shall be mechanically expanded for minimum thermal contact resistance with fins. Fin spacing shall be 10 to 12 fins per inch (4 to 5 fins per cm). Coils shall be provided with copper header and MS adaptor. Water pressure drop in coil shall not exceed 3 mt. of WC . Performance of Coil in accordance as per EN 1216 standard with a maximum tolerance of 5%.

#### **D. HEAT RECOVERY WHEEL ( EUROVENT Certified )**

Heat Recovery Section shall house wheel matrix of pure aluminium foil so as to permit quick and efficient uptake of thermal energy, sufficient mass for optimum heat transfer and maximum sensible heat recovery at a low rotational speed of 20 - 25 rpm. Non-metallic substrate will not be accepted for construction of wheel. The desiccant should have selectivity of a 3A molecular sieve desiccant for the 2.8A water molecules, and has the higher diffusivity of the 4A molecular sieves, so as to ensure the exclusion of contaminants in the air stream, while transferring only water vapour molecules, resulting in selective and fast latent recovery.

The desiccant, of sufficient mass, shall be coated with non-masking porous binder adhesive on the aluminium substrate so as to allow quick and easy uptake and release of water vapour.

The rotor/wheel matrix shall have equal sensible and latent recovery.

With optimum heat and mass through matrix formed by desiccant, of sufficient mass, coated on an aluminium foil, the rotor shall rotate at lower than 20 - 25 RPM, thereby also ensuring long life of belts and reduced wear and tear of seals.

The rotor shall be made of alternate flat and corrugated aluminium foil of uniform width.

The rotor honeycomb matrix foil should be so wound and adhered as to make a structurally very strong and rigid media which shall not get cracked, deformed etc., due to change of temperature or humidity.

The rotor having a diameter up to 2800 mm shall have spokes to reinforce the matrix. From 2000mm diameter upwards, the option of a special wing structure, to prevent the rotors from wobbling or deforming due to the successive pressure differentials, will be available.

Sectioned wheels, with pie segments, capable of being assembled in the field, shall be available as an option, above 2000 mm in diameter.

The surface of the wheel/rotor should be highly polished to ensure that the run out does not exceed  $\pm 1$  mm for every 1 metre diameter, thereby ensuring, negligible leakage, if labyrinth non-contact seals are provided, and minimal drag, if contact wiper seals are provided.

The radial run out also shall not exceed  $\pm 1$  mm for every 1 meter diameter, thereby minimising the leakage/drag on the radial seals, and minimise the fluctuation in the tension of the drive belt.

The number of wraps (of alternative corrugated and flat foil) for every inch of rotor radii shall be very consistent so as to ensure uniform air flow and performance over the entire face in the air stream. Flute height and pitch will be consistent to a very tight tolerance to ensure uniform pressure drop and uniform airflows across the rotor face.

The rotor shall be a non-clogging aluminium media, having a multitude of narrow aluminium foil channels, thus ensuring a laminar flow, and will allow particles up to 800 microns to pass through it.

The media shall be cleanable with compressed air, or low pressure steam or light detergent, without degrading the latent recovery.

The recovery wheel cassette/casing shall be manufactured from tubular structure to provide a self-supporting rigid structure, complete with access panels, purge sector, rotor, bearings, seals, drive mechanism complete with belt.

The rotor/wheel should have a field adjustable purge mechanism to provide definite separation of air flow minimising the carryover of bacteria, dust and other pollutants, from the exhaust air to the supply air. It shall be possible, with proper adjustment, to limit cross contamination to less than 0.04% of that of the exhaust air concentration.

The face and radial seals shall be four (4) pass labyrinth seals for effective sealing between the two air streams, and also for a minimum wear and tear ensuring infinite life of the seals.\_

Make – DRI

#### **E. UVC Emitters**

The specified products will be packaged with a plan and drawing for the installation of the lamp assemblies as supplied by the manufacturer's installation manual, indicating the orientation (upstream, downstream, or both sides of the coil) of the installation.

Each UV-C lamp will be attached to a reflector that will reflect the UV-C energy in order to effectively irradiate the HVAC coil surface and drain pan.

The reflector will be built from a high UV reflectivity material capable of withstanding air velocities of up to 2000 ft/min. without excessive noise, wobble, or vibration.

The electronic power supply will be mounted on a rigid surface outside of the AHU in an adequate enclosure protecting it from moisture and humidity.

#### **F. FILTERS**

##### **Primary Filters**

G4 Filter Should be washable type with a classification according to EN 779. Filter depth should not be less than 50 mm. The clean filter pressure drop should not be exceeding 75 Pa @0.94m<sup>3</sup>/s (2000 CFM), but the system should be designed for washable filters.

##### **Secondary Filters**

F7 Filter Inherently rigid filter element fastened into filter frame. The Filter media shall be washable type & pleated into mats in a zigzag format. The depth of filter should be 300mm. The filter should be designed for non-washable / disposable type filters.

F9 Filter Inherently rigid filter element fastened into a quick change filter frame, material PCGI. Filter medium synthetic glass fibre temperature resistant up to 120°C. The endurance should be up to max final pressure difference of 800 Pa, The depth of filter should be 300mm. The filter should be designed for non-washable / disposable type filters.

Filter integrity test (with EMERY 3004 oil mist or as stated in ISO guideline 14644-2) should be carried out on all HEPA filter banks. A penetration of 0.01% on filter media and seals should not be exceeded. HEPA filter frames should be well sealed with a sealant to prevent any particles by-passing the HEPA filters. The filters should be mounted by SS wing nuts. The filter integrity tests should involve individually scanning filter media, filter frames and frames to plenum seals. Filters should be easily accessible.

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## **G. ELECTRONIC AIR FILTRATION SYSTEM**

### **a) General**

It is the intent of the specification to incorporate highly efficient electronic air filtration system with low pressure drops into the building AHU system.

All AHU's shall be fitted with a true electronic air cleaner system (complete with washable pre-filter, charging section and collector section) to be installed before the cooling coils. Other forms of air filtration systems such as charged media filters, dielectric media filters, or ionizers (which do not have second stage collector plates) shall not be acceptable. The electronic air cleaner (EAC) shall be capable of removing particulates as small as 0.01 microns including microscopic haze particles, smoke, dust, mould spores and bacteria.

The EAC shall be Underwriter Laboratories (UL) Listed. The EAC shall also be EMC (Electromagnetic compatibility) certified and should meet safety and environmental criteria with reference to ES164468, UL 867 and DA 6.2.1. Ozone level of EACs provided must be within the acceptable limit of 0.05ppm.

The average capacity of the EAC shall be at least 1000cfm for the single cell unit and 2000cfm for the double cells unit. The initial atmospheric dust spot efficiency (ASHRAE 52-76) of the EAC shall be at least 67% at 2000cfm and up to 95% at 800cfm. The proposed equipment shall be capable of capturing sub-micron particulates/contaminants down to 0.3 microns. All tenderers shall submit test results of filtration efficiency by Air Filter Testing Laboratories for efficiency verification.

The solid state power supply shall provide dual voltage to the ionizer and collector section. The voltage to the ionizer shall be atleast 8000V DC to create an intense electrostatic field to allow maximum transfer of electrical charge from the ionizing wires to air particles. The voltage to the collector shall be atleast 4000V DC.

The EAC must have factory test report to ensure that it meets the following

### **Performance Testing**

- Dielectric test
- Ambient and voltage extremes
- E-field test
- Oscillatory transient test
- Lightning test
- EFT (fast transients) test
- ESD (high voltage transients) test
- EMI susceptibility test
- EMI radiation test

### **Environmental**

- Humidity
- Condensation

- Vibration

#### **b) Safety Provisions**

Each EAC cell shall have their automatic interlock switch which disconnects power and discharges the cell when the access door is opened. In addition, the EAC shall be capable of interlocking when disconnecting the power to each individual EAC unit, or when the AHU fan is not running.

A high voltage test button shall be provided for each individual high tension power supply unit to indicate the presence of high voltage on the electronic cells. An overall test button for a group of power supply units to provide a general indication of high tension voltage is not desired.

#### **c) Diagnostics / Interfacing to Building Management System**

The EAC shall have the capability of interface with the building management system through a Solid State Performance Indicator (SSPI). The following status shall be allowed for remote monitoring by the building management system as common fault:

1. Normal operation of solid-state power supply (ON)
2. Any malfunction of the system that shall cause an alarm activation (CHECK)
3. Excessive dirt accumulation in the collector cells that could result in the reduction of the EAC performance (WASH)

The EAC shall have local LEDs at each individual unit to indicate the above status and it shall be able to provide in addition a signal to link-up with the building management system for monitoring.

### **H. FRESH AIR INTAKES**

Extruded Aluminium construction duly anodised (20 microns and above ) fresh air louver with bird screen and extruded construction dampers shall be provided in the clear openings in masonry walls of the air handling unit rooms having at least one external wall. Louvers, damper, pre-filters, ducts and fresh air fan with speed regulator shall be provided as shown on Drawings and in Schedule of Quantities. Fresh air dampers shall be of the interlocking, opposed blade louver type. Blades shall be made of extruded aluminium construction and shall be rattle-free. Fresh air fans and fresh air intakes shall be per the requirements of Schedule of Quantities.

### **I. ELECTRICAL & CONTROL PANEL**

The air handling unit shall have inbuilt integrated electrical starter panel with AUTO/Manual over ride switch for operation. Control cabinet to be provided with IP 65 enclosure which should be mounted on AHU surface/flushed inside the AHU casing. The electric panel provided for the unit must be equipped with main incoming contactor additionally the unit must be provided with MCBs with busbar for single incomer provision , additionally SMPS must be provided for power supply to the unit controller. Potentiometer shall be an integral part of the panel for manual speed control. Each unit shall have an Internal mounted Power cum control marshelling box of IP 65 protection with door and hinges with provision to mount power and control wirings with DDC controller.

Provision for 24 V DC power supply for PIBCV valve shall be part of the control panel.

#### **J. MICRO PROCESSOR CONTROLLER**

The controller should have minimum 20 I/O points and RS485 ports for BMS Connectivity using Modbus RTU protocol / BACnet IP connectivity. The power input to the controller shall be 24 v DC and provision shall be made for the same in the control panel by AHU manufacturer. Each Unit shall be equipped with minimum 7’’ HMI with touch screen for monitoring and controlling the AHU which shall be IP 65 protection.

Touch screen HMI shall be default option even not specified in the BOQ. As a standard the controller / DDC must be compatible to connect to a laptop or display for configuring or viewing unit performance parameters.

Marshalling box should be factory fitted with termination of all control cables and RS 485 output of fan duly mounted inside the AHU panel. All wiring should be carried out by the AHU manufacture at factory with proper ferule for tagging purpose.

The control panel for EC fans should be in the scope of AHU manufacturer and should be factory fitted.

The controller to have the following inputs / outputs (To be incorporated as per control logic):

- Temperature / RH / Pressure connectivity as per devices options.
- Integration to fire panel
- Provision for fire damper integration
- Fan wall program for EC fans with individual status of fans thru Modbus
- Run hour status of each fans
- Kw / amp consumption of each fan on the fan wall
- CO2/VOC sensor connectivity – optional, if mentioned in the BOQ
- VFD connectivity via Rs485 (Modbus slave) – optional, if mentioned in the BOQ
- I/O summary
- Multiple controller (Slave) connectivity.
- Modbus RTU (485/IP) compatible output to BMS.
- Feedback from sensor etc and regulate the fan speed/ valve opening.
- Automatic load / time and alarm sequencing function to be performed by the unit.
- Microprocessor must have output point for ON/OFF of motorized outlet damper and must be suitable to be integrated with fire point for unit shut off in case receiving signal from fire panel or fire detectors.

Instrumentation: The following sensors shall be part of AHU package for modulation of fan and control valves

1. CHW temperature Sensor
2. Pressure Sensor/ DP sensor for fan speed control
3. DP switch across all filters
4. Co2 sensor for damper modulation
5. Velocity Sensor for Flow measurement



### **Important Guidelines**

A minimum gap of 800 mm shall be maintained between Microvee filter and HEPA filter. A minimum gap of 800 mm shall be maintained between HEPA filter & Plenum dead end.

Plenum, housing of HEPA filters shall be extended at least 700mm on both sides (Upstream and Downstream) of HEPA Filters for easy testing and maintenance of filters.

Access Door (Minimum 600 mm) Wide in each section and in each Plenum housing. Limit switches shall be provided in Fan section doors and shall be interlocked with AHU Fan motor(s) and inspection lamp.

Required number of Compression glands for Power/Signal Cable should be provided.

Plastic nozzles with plug should be provided for DOP testing of HEPA Filters. Pressure measuring nozzles shall be provided in Upstream as well as in downstream side of each filter set and fan section.

### **K. SAFETY FEATURES**

Each Air Handling Unit must have safety features as under:

- a) The Fan Access Door shall be equipped with micro-switch inter locked with fan motor to enable switching off the fan motor automatically in the event of door opening.
- b) The Access Door shall further have wire mesh screen as an added safety feature bolted on to the unit frame.
- c) Fan and motor base shall be properly grounded.

### **L. ACCESSORIES**

Each air handling unit shall be provided with manual air vent at high point in the cooling/heating coil and drain plug in the bottom of the coil. In addition, the following accessories may be required at air handling units, their detailed specifications are given in individual sections, and quantities separately identified in Schedule of Quantities.

- a) Motorised three way mixing valves located in chilled/hot water lines connecting to the coil. This valve shall be operated by the cooling/heating thermostat & shall control the flow of chilled/hot water.
- b) Cooling/heating thermostats.
- c) Insulated butterfly valves/balancing valves, 'Y' strainer, union & condensate drain piping upto sump or floor drain in air handling unit room.
- d) Thermometers in the thermometer wells & pressure gauge (with cocks) within gauge ports in chilled/hot water supply and return lines.

### **M. PERFORMANCE DATA**

Air handling units shall be selected for the lowest operating power consumption and noise level of the equipment. Fan performance rating and power consumption data, with operating points clearly indicating shall be submitted and verified at the time of testing/ commissioning of the

installation.

#### **N. Factory Acceptance Test ( FAT )**

One unit of each type of unit shall be inspected at factory for

- Run Test for Air quantity v/s static pressure
- Casing Leak Test as per DW 143 standard
- Pneumatic pressure test of Heat Transfer coil at 21Kg/sq.cm
- Vibration of unit
- Noise level at 1.5 m distance at factory condition
- Power consumption
- Dimensional check of unit
- Verification of Test certificates of components / calibration certificates of all instruments used during inspection.

### **3.2 DUCT WORKS**

#### **3.2.1 GENERAL**

Sheet Metal Duct Works shall be carried out in accordance with either SMACNA or B.I.S. (IS 655) guidelines, as asked for in BOQ. SMACNA guidelines (upward modified in this specification) shall be adopted for factory fabricated ducts, and BIS Codes shall be adopted for site fabricated ducts.

#### **3.2.2 Duct Material**

- a. All ducts shall be fabricated either from Galvanised Sheet Steel (GSS) conforming to IS: 277 or aluminium sheets conforming to IS:737. The steel sheets shall be hot dip galvanized with MAT finish with coating of minimum 120 grams per square meter (GSM) of Zinc, GI sheets shall be lead free, eco friendly and RoHS compliant
- b. The thickness of sheets for fabrication of rectangular ductwork shall be as under. The thickness required corresponding to the longest side of the rectangular section shall be applicable for all the four sides of the ductwork.

Longest side (mm)	Minimum sheet thickness	
	For GSS	For Al.
750 mm and below	0.63	0.80
751 mm to 1500 mm	0.80	1.00
1501 mm to 2250 mm	1.00	1.50
2251 mm & above	1.25	1.80

- c. Contractor shall prepare shop drawings, coordinated with the working drawings and the ceiling plans made by Architect.
- d. Contractor shall fabricate, supply, install, test and balance air system and establish the air

- balance schedule.
- e. Contractor shall include in his costing all supporting, suspension and air balancing devices.
  - f. Supply/ return air outlets, F.A. grilles and accessories shall be constructed from extruded aluminium sections.
  - g. Flanges for matching duct sections, stiffening angles (braces) and supporting angles shall be of rolled steel sections, and shall be of the following sizes:

Application	Duct Width	Angle size
Flanges	Upto 1000 mm	35 mm x 35 mm x 3 mm
-do-	1001 mm to 2250 mm	40 mm x 40 mm x 3 mm
-do-	More than 2250 mm	50 mm x 50 mm x 3 mm
Bracings	Upto 1000 mm	25 mm x 25 mm x 3 mm
-do-	More than 1000 mm	40 mm x 40 mm x 3 mm
Support angles	Upto 1000 mm	40 mm x 40 mm x 3 mm
-do-	1001 mm to 2250 mm	40 mm x 40 mm x 3 mm
-do-	More than 2250 mm	Size and type of RS section shall be decided in individual cases

- h. Hanger rods shall be of mild steel and of at least 10 mm dia for ducts upto 2250 mm size, and 12 mm dia for larger sizes.
- i. All nuts, bolts and washers shall be zinc plated steel. All rivets shall be galvanised or shall be made of magnesium - aluminium alloy. Self tapping screws shall not be used.

### 3.2.3 LIST OF BUREAU OF INDIAN STANDARDS CODES

IS: 1234 (Part - I) - 1474	Mild steel tube
IS: 1234 (Part - II) - 1482	Mild steel Tubulars and other Wrought steel pipe fittings
IS: 4736 - 1468	Hot-dip zinc coatings on steel tubes
IS: 823 - 1464	Code of procedure for manual metal arc welding of mild steel
IS: 780 - 1480	Sluice valves for water works purposes
IS: 778 - 1480	Copper alloy gate, lobe and checks Valves for water works purposes
IS: 1536 - 1476	Flanges configuration

IS: 2374 - 1463	Colour code for the identification of pipelines
IS: 554 - 1475	Dimensions for pipe threads where pressure tight joints are required on the threads.
IS: 655 - 1463	Metal air ducts
IS: 277 - 1477	Galvanized steel wire for fencing.
IS: 4064 - (Part -II) - 1478	Specific requirements for the direct switching of individual motors.
IS: 3854-1464	Switches for domestic & similar Purpose
IS: 644-1477	PVC insulated (HD) electric cables For working voltage upto and Including 1100 Volts.
IS: 4224 (Part II) - 1474	HRC cartridge fuse links upto 650 volts.
IS: 8544 (Part-I to IV)-1474	Starters
IS: 732 (Part-III)-1482	Inspection and testing of installation.
IS: 654-1464	Air Conditioning (Safety Code)
IS: 660-1463	Mechanical Refrigeration (Safety Code)
IS: 4844-1487	Test Code for Centrifugal Fan.
IS: 3103-1475	Code of practice for Industrial Ventilation
IS: 7240-1481	Application & Finishing of thermal insulation material

In case of any revision in above BIS code. The REVISED one shall only be applicable.

**a. DUCT DESIGN PARAMETERS (Rectangular / Square)**

Maximum Flow Velocity	1100/1500 FPM	450 MPM
Maximum Friction	0.08 WG/100 FT Run	5MM WG/100 M Run
Maximum Velocity at SA outlet	500 FPM	150 MPM
Maximum flow velocity in exhaust duct	1800 FPM	550M

**3.3 CONSTRUCTION**

**a. Ducts**

- i) Ducts shall be fabricated at site or factory fabricated and shall be generally as per IS: 655 "Specifications for metal air ducts", unless otherwise deviated in these General Specifications.

- ii) The interior surfaces of the ducting shall be smooth.
- iii) All the ducts upto 600 mm longest side shall be cross broken between flanges by a single continuous breaking. Ducts of size 600 mm and above shall be cross broken by single continuous breaking between flanges and bracings. Alternatively, beading at 300 mm centres for ducts upto 600 mm longest side, and 300 mm centres for ducts above 600 mm size shall be provided for stiffening.
- iv) As far as possible, long radius elbows and gradual changes in shape shall be used to maintain uniform velocity accompanied by decreased turbulence, lower resistance and minimum noise. The ratio of the size of the duct to the radius of the elbow shall be normally not less than 1:1.5.
- v) Flanged joints shall be used at intervals not exceeding 2500 mm. Flanges shall be welded at corners first and then riveted to the duct.
- vi) Stiffening angles shall be fixed to the sides of the ducts by riveting at 1.25 meters from joints for ducts of size 600 mm to 1500 mm, and 0.6 m from joints for ducts of size larger than 1500 mm. Bracings for ducts larger than 1500 mm can alternatively be by diagonal angles.
- vii) Plenums for filters shall be complete with suitable access door of size 450 mm x 450 mm.
- viii) All factory fabricated duct shall be supplied in L sections, the length of any piece shall not be more than 1800 mm for duct with longest side of cross section as 600 mm and above and 3000 mm for rest.

**b. Air Outlet and Inlets (Supply and Return)**

- i. All air outlets and intakes shall be made of extruded aluminium sections & shall present a neat appearance and shall be rigid with mechanical joints.
- ii. Square and rectangular wall outlets shall have a flanged frame with the outside edges returned or curved 5 to 7 mm and fitted with a suitable flexible gasket between the concealed face of the flanges and the finished wall face. The core of supply air register shall have adjustable front louvers parallel to the longer side to give upto 22.5 degrees vertical deflection and adjustable back louvers parallel to the shorter side to achieve a horizontal spread air pattern to at least 45 degrees. Return air grilles shall have only front louvers. The outer framework of the grilles shall be made of not less than 1.6 mm thick aluminium sheet. The louvers shall be of aerofoil design of extruded aluminium section with minimum thickness of 0.8mm at front and shall be made of 0.8mm thick aluminium sheet. Louvers may be spaced 18 mm apart.
- iii. Square and rectangular ceiling outlets/intakes shall have a flange flush with the ceiling into which it is fitted or shall be of anti smudge type. The outlets shall comprise an outer shell with duct collar and removable diffusing assembly. These shall be suitable for discharge in one or more directions as required. The outer shell shall not be less than 1.6 mm thick extruded section aluminium sheet. The diffuser assembly shall not be less than 0.80 mm

thick extruded aluminium section.

- iv. Circular ceiling outlets/intakes shall have either flush or anti smudge outer cone as specified in the tender specifications. Flush outer cones shall have the lower edge of the cone not more than 5 mm below the underside of the finished ceiling into which it is fitted. Anti smudge cones shall have the outer cone profile designed to reduce dirt deposit on the ceiling adjacent to the air outlet. The metal sheet used for construction of these shall be minimum 1.6 mm thick extruded aluminium sheet.
- v. Linear diffusers shall have a flanged frame with the outside edges returned 3.5 mm and shall have one to four slots as required. The air quantity through each slot shall be adjustable. The metal sheet used for the construction of these shall be minimum 1.6 mm thick extruded aluminium sheet.
- vi. Grilles and diffusers constructed of extruded aluminium sections shall have grille bars set straight, or deflected as required. These shall be assembled by mechanical interlocking of components to prevent distortion. These grilles and diffusers shall have a rear set of adjustable blades, perpendicular to the face blades for deflection purposes.
- vii. All supply air outlets shall be fitted with a volume control device, made of extruded aluminium gate section. The blades of the device shall be mill finish/ block shade pivoted on nylon brushes to avoid rusting & rattling noise, which shall be located immediately behind the outlet and shall be fully adjustable from within the occupied space without removing any access panel. The volume control device for circular outlets shall be opposed blade radial /shutter type dampers, or two or more butterfly dampers in conjunction with equalizing grid. Opposed blade dampers shall be used for square and rectangular ceiling/wall outlets and intakes.
- viii. All the products supplied by contractor should supplement in performance by selection curves of product ratings from the manufacturer.
- ix. Laminar supply air diffusers shall be made of 2mm thick powder coated aluminium sheet duly insulated with 5mm thick closed cell polyethylene foam insulation having factory laminated aluminium foil and joints covered with self adhesive aluminium tape and having holes 2/3 mm dia including frame work.

#### **c. Fresh Air Intakes Louvers with Bird Screen**

- i. Fresh air intake louvers at least 50 mm deep shall be made of powder coated extruded aluminium sections.
- ii. A flanged frame using RS sections shall be provided on front face to conceal the gap between the louvers and the adjoining wall face. Corners of frame shall be welded. The frame shall be made structurally rigid.
- iii. Louvers made from extruded aluminium section shall be in modular panel form for ease of handling. These shall be free from waves and buckles. Vertical blades shall be truly vertical and horizontal blades shall be truly horizontal. Butt joints in blades shall not be accepted.

- iv. Additional intermediate equally spaced supports and stiffeners shall be provided to prevent sagging/ vibrating of the louvers, at not more than 750mm centres where the louver's length is longer than 750mm.
- v. A bird wire screen made of 12 mm mesh in 1.6 mm steel wire held in angle or channel frame shall be fixed to the rear face of the louver frame by screens.

**d. Flexible Ducting**

Flexible Duct is a round, flexible light weight duct and is preliminary used for

- i. Speedy completion of project
- ii. Offers a high degree of flexibility, which allows it to be easily connected to any desired position.
- iii. A quick and economical means of correcting misalignment between system components.
- iv. Allows ducting around obstacles where fabricated and fitted ducts would be difficult and costly to install.

Flexible duct is constructed as described below:

- i. An uninsulated flexible duct shall be made of double lamination of metalized polyester film permanently bonded to a coated spring steel wire helix. Duct shall be in tear & puncture resistant construction.
- ii. For insulated flexible duct where specified, inner core for the same should be made of double lamination of metalized polyester film permanently bonded to a coated spring steel wire helix. Fiberglass insulation of minimum 14 kg/cu.m density, 25 mm thickness shall be wrapped over the inner core & covered with strong outer jacket cum vapour barrier made of fibre glass reinforced metalized polyester film laminate.
- iii. Care must be taken to install all the flexible duct in fully extended position & bends made with adequate radius as per manufacturer recommended practices.

**3.3 FIRE DAMPERS**

- i) Fire dampers shall be provided in all the supply air ducts and return air ducts (where provided), return air passage in the air-handling unit room and at all floor crossings. Access door will be provided in the duct before each set of fire dampers.
- ii) Fire dampers shall be multi blade louvers type. The blade should remain in the air stream in open position & shall allow maximum free area to reduce pressure drop & noise in the air passage. The blades and frame shall be constructed with minimum 1.6mm thick galvanised sheet & shall be factory fitted in a sleeve made out of 1.6mm galvanised sheet of minimum 400mm long. It shall be complete with locking device, motorised actuator & control panel.
- iii) Fire dampers shall be motorised smoke & fire dampers type. It shall be supplied with spring loaded UL stamped fusible link to close fire damper in the event of rise in duct temperature. Fire damper shall also close on receipt of fire alarm signal to cut off air

supply instantaneously. An electric limit switch shall also be operated by the closing of fire damper, which in turn shall switch off power supply to AHU blower motor as well as strip heaters.

- iv) Fire dampers shall be CBRI tested & certified for 90 minutes rating against collapse & flame penetration as per UL 555-1995.(Under writers laboratories)
- v) Fire dampers shall be compatible with the fire detection system of building & shall be capable of operating automatically through an electric motor on receiving signal from fire alarm panel.
- vi) Necessary wiring from fire alarm panel up to AHU electric panel shall be provided by the department & further from AHU electric panel to fire damper shall be provided by air conditioning contractor.

### **3.4 INSTALLATION OF METALLIC DUCT**

#### **a. Ducting**

- i. The fabrication and installation shall be in a workmanlike manner. Duct work shall be rigid and straight without kinks.
- ii. All exposed ducts within the conditioned space shall have slip joints. Flanged joints shall not be used.
- iii. All joints shall be airtight.
- iv. Ducts shall be supported independently from the building structure and adequately, to keep the ducts true to shape. The support spacing shall be not more than 2 m. where ducts cannot be suspended from ceiling, wall brackets or other suitable arrangements, as approved by the Engineer-in-charge shall be adopted. Neoprene or other vibration isolation packing of minimum 6 mm thickness shall be provided between the ducts and the angle iron supports/brackets. Vertical duct work shall be suitably supported at each floor by steel structural members.
- v. Where metal ducts or sleeves terminate in woodwork, tight joints shall be made by means of closely fitting heavy flanged collars. Where ducts pass through brick or masonry openings, wooden frame work shall be provided within the openings and the crossing ducts shall be provided with heavy flanged collars on either side of the wooden frame work, so that duct crossing is made leak-proof.
- vi. Duct connections to the air-handling unit shall be made by inserting a double canvas sleeve 100 mm long. The sleeve shall be securely bonded and bolted to the duct and unit casing.
- vii. Dampers shall be provided in branch duct connections for proper volume control and balancing the air quantities in the system, whether indicated in the drawings or not. Suitable links, levers and quadrants shall be provided for proper operation, control and setting of the dampers. Every damper shall have an indicating device clearly showing the position of the dampers at all times.



- viii. Where electrical heaters are mounted in the duct, these shall be of low temperature totally enclosed type fitted with radiation fins. A removable panel for access to the heaters shall be provided in the duct. Any hole in the duct for electrical wiring must be provided with suitable bushes to avoid leakage. 6 mm thick asbestos board lining shall be provided all around the inside of the duct for a distance of 30 cms. on either side of the electrical heaters. A manually reset thermostatic safety switch shall be provided near the duct section having heaters. In addition, the heaters must be interlocked with the connected fan motor of the AHU.

**b. Air Outlets and Inlets**

- i. The locations of the air outlets and intakes shall be shown in the tender drawings and necessary openings and the wooden framework for fixing the grilles shall be provided by the air conditioning contractor. The location of these outlets/ inlets is subject to change and the approval of the Engineer-in-Charge shall be obtained before finally fixing the grilles/diffusers in position.
- ii. In installing fresh air intakes, no fixing device shall be visible from the face of the frame. Where louvers are to be fixed in masonry or concrete, fixing shall be with either expanding plugs or raw plugs. Where the louvers are to be fixed in steel or wood, non-ferrous screws or bolts shall be used.
- iii. Supply air outlets and return air intakes shall be anodized/ powder coated aluminium to the desired colour to match the surroundings wall/ceiling. The fresh air intakes shall be anodized/ powder coated aluminium as approved by the Engineer-in-Charge. The paint colour shall be approved by the Engineer-in-Charge.
- iv. All damages to the finish of the structure during the installation work shall be made good by the air-conditioning contractor before handing over the installation to the Department.

**3.5 Access Doors**

- a. All main work shall be accessible throughout using tight fitted hinged access doors. Doors shall be provided with neoprene rubber gaskets. Angle joints shall be provided with neoprene rubber gaskets for leak-tightness of the joints.
- b. Access door / panels shall be provided at following places.
- c. Any other places specifically mentioned in the drawing or if envisaged by the owner / consultants during execution stage.
- d. In case access doors are to be installed in the insulated ducts, the access door panel shall be double skin construction with insulation filled in such that it can be operated without damaging the duct insulation.

**3.6 Balancing**

Air systems shall be balanced in a manner to minimize throttling losses. The entire air distribution system shall be balanced with the help of an anemometer. The measured air quantities at fan discharge and at the various outlets shall be within  $\pm 5$  percent of those specified/quoted. For fans greater than 0.75 KW (1.0 HP), fans must then be adjusted to meet design flow conditions. Branch duct adjustments shall be permanently marked after the air balancing is completed so that these can be restored to their correct position if disturbed at any time.

### **3.7 Measurement**

- i) Duct measurements (for insulated ducts) shall be taken before application of insulation.
- ii) Duct work shall be measured section wise on the basis of external surface area by multiplying the axial length from flange face to flange face for each section by the corresponding duct perimeter in the centre of that section length.
- iii) Uniformly tapering straight sections shall also be measured as in (ii) above. However, for special pieces like tees, bends etc. area computations for surface areas shall be done as per the shape of such pieces.
- iv) The quoted unit rate for external surfaces of ducts shall include all wastage allowances, flanges, gaskets for joints, vibration isolators, bracings, hangers and supports, inspection chambers/access panels, splitter dampers with quadrants and levers for position indication, turning vanes, straightening vanes, and all other accessories required to complete the duct installation as per the specifications. These accessories shall not be separately measured.
- v) Grilles and diffusers (except linear diffusers) shall be measured by the cross sectional areas, perpendicular to the airflow, and excluding the flanges. Volume control dampers, where provided shall not be separately accounted for.
- vi) Linear diffusers shall be measured by linear measurements only, and not by cross-sectional areas, and shall exclude flanges for mounting of the linear diffusers. The supply air plenum for linear diffusers shall be measured as described above for ducting.
- vii) Fire dampers shall be measured by their cross sectional area perpendicular to the direction of the airflow. Quoted rates shall include the necessary collars and flanges for mounting, inspection pieces with access door, fusible link/solenoid with wiring, but excluding the fire detectors, etc.

### **3.8 Leakage Test**

Test duct for leakage by using test kits containing test blowers, two U tube manometers, and calibrated curve attached to the orifice tube assembly.

The above mentioned test would be a pilot test, and subsequently, if the construction manager / consultant asked for then Halogen / Metal Halide damp test / smoke test could be carried out, prior to branch / collar works.

### **3.9 Mechanical Noise and Vibration Control**

- a. Flexible connections shall be provided on all duct work connections to fans, rotating plant and equipment isolated from structure and anti-vibration materials or mountings. Pipe work and duct work crossing building movement or construction joints shall be installed with flexible connections.

- b. Flexible connection on duct work to fans etc. Shall be a minimum/ maximum free length of **100mm / 200mm** respectively to minimize noise transmission and noise break out. They shall be completely free from stress and shall not be required to accept any weight.
- c. Thickness and strength of flexible connection materials shall be suitable to withstand the positive and negative fan pressure to which they will be subjected to and shall not allow perceptible leakage. The materials shall be durable, non flammable having good acoustical quality.

### 3.10 Silencers

- a. Duct sound attenuators / silencers of the following specifications would be installed wherever asked for in the drawings and the BOQ.
- b. All plant attenuators shall be selected to maintain noise criteria given in this specification.
- c. The outer casing shall be out of min. 22G galvanised steel in accordance with ASHRE (ISI) recommendations for high pressure rectangular duct work. Seams shall be lock formed on pittsburg lock machine.
- d. Interior elements of silencers shall be out of min. 22 G galvanised perforated steel.
- e. Acoustic fill shall be Fibre glass of density not less than 48 kg/m<sup>3</sup> sufficient to obtain specified acoustic performance and shall be packed under 10% compression to eliminate voids due to vibration and setting. Material shall be inert, vermin and moisture proof. All material of construction and acoustic fill shall be incombustible as per IS 3144.
- f. All silencer shall be selected against a maximum allowable air pressure drop of **10mm**. Air tight construction shall be provided by use of duct sealing compound at site by the air conditioning contractor.
- g. Acoustic Performance Silencer acoustic ratings shall include insertion loss and self-noise power levels and shall meet or exceed minimum performance. Contractor shall provide computer selection for the silencer supplied at site which will indicate db reduction at different octave band frequency.
- h. Aerodynamic Performance Static pressure drop through silencers shall not exceed those listed in the silencer schedule at the indicated airflows.
- i. Transitions Where transitions are required to adapt silencer dimensions to connecting duct work, they would be supplied by the installing contractor.

### 3.11 AIR REGISTERS

Scope included following:

- a. Air Distribution Registers, grilles, diffusers.
- b. Fire / Smoke Dampers
- c. Access Doors
- d. Outside Air Louvers
- e. Flexible Ducts

The quality control of these items are governed as specified below:

- a. Air Diffusers/Grilles: As per ratings by Air Diffusion Council / As per approved manufacturer.
  - b. Fire / Smoke / Combination dampers : UL , NFPA 90A / 90 B.
- 
- a. **Air Register**

The scope of this section includes supplying, installation, testing, balancing and commissioning of various air distribution products as specified here under. All air distribution products shall have guaranteed performance rating as regards to air quantity, throw, noise level and pressure drop etc. Contractor has to provide selection curves at the time of supply.
  - b. **Supply and Return Registers and Ceiling Terminals**

Supply and return air registers and ceiling terminals shall be made of extruded aluminum section as specified in BOQ. The registers/terminals shall be either anodized or powder coated in finish as given in BOQ. Supply air registers/terminals shall be provided with screw operated opposed blade volume control device of extruded aluminum in mill finish. The registers shall be suitable for fixing arrangement concealed or visible screw as approved by architect/consultant.

All registers shall be selected as per selection curves and in consultation with architect/consultant. All registers shall have soft continuous rubber/ foam gasket between the periphery of the registers/terminals and the surface on which it has to be mounted.
  - c. **Linear Registers**

Linear continuous supply or return air register shall be extruded aluminum construction with fixed horizontal bars at 0 ° or 15 ° inclination with one way or two way deflection and flanges on both sides. The thickness of fixed bar louvers shall be 5 mm in front and the flange shall be 20 mm wide with round edges. The register shall be suitable for concealed fixing and horizontal bars of the register shall be mechanically crimped from the back to hold them.

Volume control device of extruded aluminum construction in mill finish shall be provided in S.A. duct collars.
  - d. **Single Individual Adjustable Louvered Supply or Return Air Register**

Single individual adjustable horizontal /vertical supply or return air register shall be made of extruded aluminum construction. The louvers shall hold deflection settings under all conditions of velocity and pressure since mounted on Nylon bushes. The register shall have 20 mm wide flange all around with front screw fixing. Volume control device of extruded aluminum / GI construction in mill finish shall be provided in S.A. duct collars.
  - e. **Double Adjustable Louvered Supply/Return Air Register with Horizontal / Vertical or Vertical/Horizontal Louver Arrangement**

The register shall be adjustable as each louver shall be pivoted to provide pattern with 0° to plus or minus 15° arc up to 30° deflection down towards. The louver shall hold deflection

settings under all conditions of velocity and pressure. The Rear louver of the register shall be in black shade.

Volume control device of extruded aluminium construction with mill finish shall be provided in S.A. duct collars.

f. **Rectangular Fixed Bar Register**

Supply/Return air all side flange air register shall be extruded aluminium construction with fixed horizontal bars at 0° or 15° inclination with one way or two way deflection and flanges on both sides. The thickness of fixed bar louvers shall be 5 mm in front and the flange shall be 20 mm wide with rounded edges. The register shall be suitable for concealed fixing and horizontal bars of the register shall be mechanically crimped from the back to hold them.

g. **Exhaust Air Register**

Exhaust air register shall be made of extruded aluminium with fixed horizontal louvers at 40° angle setting on a 20 mm louver pitch. The register shall have 20 mm wide flange with round edges all around. The register shall be suitable for front screw fixing.

Volume control device of extruded aluminium construction in mill finish shall be provided in S.A. duct collars.

h. **Square Ceiling Air Terminals**

Square/Rectangular ceiling air terminals shall be made of extruded aluminium construction with flush fixed pattern. The terminals shall have Anti-Smudge ring and spring loaded removable central core in various pattern for air flow direction. The terminal shall be mounted by concealed screw fixing arrangement. The supply air terminal to be supplied with Volume control device of extruded aluminium construction in mill finish.

i. **Curved Blade Ceiling Terminals**

Square /rectangular curved blade ceiling terminals shall be made of extruded aluminium. The terminals shall have individual adjustable blades mounted on nylon bushes which facilitate to adjust the direction of air as per site conditions. The terminals shall have 20 mm wide flanges all around and concealed screw fixing arrangement. The supply air register to be supplied with Volume control device of extruded aluminium construction in mill finish.

j. **Volume Control Device**

Opposed blade volume control device shall be made of all extruded aluminium construction in mill finish. Opposed blades shall be pivoted to extruded aluminium frame with Nylon bushes. Specially designed blade have an overlapping lip which ensure a tight closure.

k. **Ventilation Air Intake Louvers**

Ventilation air intake louvers 50 mm deep wherever required as per shop drawing will be made of extruded aluminium construction duly Anodised or Powder coated. Bird/insect screen will be provided with the intake louvers. The blades are inclined at 45 ° on a 40 mm blade pitch to minimise water ingress. The lowest blade of the assembly shall extended out slightly to facilitate disposal of rain water without falling in door/wall on which it is mounted.

Wherever specified, the intake louvers shall be provided with factory fitted all aluminium construction volume control dampers in mill finish.

l. **Storm Proof Louvers**

80mm deep wherever required as per shop drawing will be made of extruded aluminium construction. The blades are inclined at 45 degree on 75 mm blade pitch to minimise water ingress. The lowest blade of the assembly shall extended out slightly to facilitate disposal of rain water without falling in door / wall on which it is mounted.

m. **Air Transfer Door Register**

Extruded aluminium construction air transfer door register will be provided as per approved shop drawings. The register will be complete with single /double register frame to be mounted on door panel from both sides. The central core shall be NO- SEE-THRU type. The register shall be anodised or powder coated as per Architect's requirement. The register shall be provided with insect screen to prevent movement of insects from inside to outside or vice versa.

n. **Motorised Combined Smoke & Fire Dampers - Spring Return**

All Supply and Return Air Ducts at AHU room crossings and at all floor crossings shall be provided with approved make fire and smoke dampers of atleast 120 minutes fire rating certified by CBRI Roorkee as per UL 555:1973.

- o. Fire Damper blades & outer frame shall be formed of 1.6MM galvanised sheet steel. The damper blade shall be in pivoted on both ends using chrome plated spindles in self lubricated bronze bushes. Stop seals will be provided on top and bottom of the damper housing made of 16 G galvanised sheet steel. For preventing smoke leakage side seals will be provided.
- p. In normal position damper blade shall be held in open position with the help of a 24V operated electric actuators thereby providing maximum air passage without creating any noise or chatter.
- q. The damper shall be actuated through electric actuator. The actuator shall be energised with the help of a signal from smoke detector (supplied by others) installed in AHU Room/R.A.Duct/Damper. The Fire Damper shall also close due to Temp.rise in S.A. Ducts thru the Electric Temp.sensor factory set at 165° F micro switches with bakelite base will be provided to stop fan motor and give open & close signal at remote panel in case of motorised actuator.
- r. Each Dampers in case of motorised Smoke-cum-Fire Damper shall have its own panel which will incorporate necessary circuit required to step down voltage available from UPS or Emergency Power Supply to shown status of the damper (open or close), to allow remote testing of damper & indication in event of damper closure due to signal from smoke sensor/Temp.sensor & reset button. Additional Terminal will be provided to have signal (sound beep or visual) in Central Control Room.
- s. Damper Actuator shall be spring return so as to close the damper in the event of power failure automatically and open the same in case of power being restored.

- t. The Fire Dampers shall be mounted in fire rated wall with a duct sleeve 400MM long. The sleeve shall be factory fitted on fire damper. The joints at sleeve end shall be Slip on type. Minimum thickness of G1 Sheet shall be 18 G.
- u. The damper shall be installed in accordance with the installation method recommended by the manufacturer.
- v. After installation of Fire Dampers, contractor will co-ordinate with the civil contractor on site and get the extra openings sealed, and then finally finish the installation by sealing the area, using approved make of mastic fire sealant.

### 3.12 INSULATION

This scope covers the specifications for insulation of Exposed, Concealed, Outdoors and Underground works.

Insulation, adhesives, coatings, sealant, tapes, shall have a flame spread rating of 25 or less and smoke development of 50 or less in accordance with UL 723.

#### a. Pipe and Equipment Insulation

Provide factory pre-molded of material specified in section type insulation material for pipes and equipment.

- The Pipe insulation basic material shall be cross linked closed cell Class-O Oxide Acetate Foam or Class-O closed cell elastomeric nitrile rubber. Insulation should be of minimum thickness as mention in the BOQ.
- The Pipe insulation shall be with Factory pre-laminated Aluminum foil for mechanical protection where the men approach to damages the Oxide Acetate foam surface. Insulation should be of minimum thickness as mention in the BOQ.
- Density of Material shall be between  $30 \pm 3 \text{ Kg/m}^3$ .
- Thermal conductivity of Oxide Acetate foam shall not exceed  $0.029 \text{ W/mK}$  at mean temperature of  $0^\circ \text{C}$  and  $0.35 \text{ W/mK}$  at  $27 \pm 2 \text{ Deg C}$ .
- Insulation material shall be UV resistive, anti-microbial and anti-fungal with zero rating fungal growth as per ASTM –G -21
- Insulation material should not have any effect of acids and alkalis as per IS:9845-1998
- The insulation shall have fire performance such that it passes Class 1 as per BS476 Part 7 for surface spread of flame as per BS 476 and also pass Fire Propagation requirement as per BS476 Part 6 to meet the Class 'O'.
- Water vapor permeability shall be negligible as per DIN EN ISO : 12572 , i.e. Moisture Diffusion Resistance Factor or ' $\mu$ ' value should be minimum 12800.
- The insulation material passes Smoke and Toxicity test as per (IMO Resolution MSC -307 (88) (2010 FTP Code): Annex 1: Part 2
- Material shall be CFC/ HCFC free as per US EPA 5021 A(2014 ).

#### b. Recommended Adhesive

Adhesive used for sealing the insulation shall be based on polychloroprene with special rosin and tacky fire. The adhesive shall be R-242 grade nonflammable in dry form and solid 26% ( $\pm 2\%$ ) with heat, water & chemical resistance with the determination of ASTM-D 903,

ASTM-D 3960 ( $\leq$  **less than** or equal to 264 gm/ltr.). The application method of adhesive strictly follows as per adhesives manufacturer's technical data sheet.

**Following installation procedure should be adopted:**

- The pipe shall be thoroughly cleaned with a wire brush and rendered free from all rust and grease.
- The pipes shall be treated with coats of adhesive properly.
- The insulation preformed section shall be fixed tightly to the surface taking care to seal all joints with 50mm wide aluminum adhesive tape (transverse and circumferential). (If any)
- The insulation shall be tied with PVC band not less than 6mm width and 25 Gauge 4 bends per meter or equivalent plastic band using G.I. sheet clamp crimped at the joints.

**c. Duct-in-Line Thermal Insulation**

External thermal insulation shall be provided as follow:

- The duct insulation Basic material shall be cross linked closed cell Oxide Acetate Foam. Insulation should be of minimum thickness as mention in the BOQ.
- The duct insulation shall be with Factory pre-laminated Aluminium foil for mechanical protection where the men approach to damages the Oxide Acetate foam surface. Insulation should be of minimum thickness as mention in the BOQ.
- Density of Material shall be between  $30 \pm 3 \text{ Kg/m}^3$ .
- Thermal conductivity of Oxide Acetate foam shall not exceed  $0.029 \text{ W/m.K}$  at mean temperature of  $0^\circ\text{C}$  and  $0.35 \text{ W/mk}$  at  $27 \pm 2 \text{ Deg C}$ .
- Insulation material shall be UV resistive, anti-microbial and anti-fungal with zero rating fungal growth as per ASTM –G -21
- Insulation material should not have any effect of acids and alkalis as per IS:9845-1998
- The insulation shall have fire performance such that it passes Class 1 as per BS476 Part 7 for surface spread of flame as per BS 476 and also pass Fire Propagation requirement as per BS476 Part 6 to meet the Class 'O'.
- Water vapor permeability shall be negligible as per DIN EN ISO : 12572 , i.e. Moisture Diffusion Resistance Factor or ' $\mu$ ' value should be minimum 12800.
- The insulation material passes Smoke and Toxicity test as per (IMO Resolution MSC - 307 (88) (2010 FTP Code): Annex 1: Part 2
- Material shall be CFC/ HCFC free as per US EPA 5021 A(2014 ).

**Following installation procedure should be adopted:**

The thickness of the cross linked closed cell Oxide Acetate Foam shall be as mentioned below and in the in the schedule of quantity. Following installation procedure should be adopted:

- Duct surfaces shall be cleaned to remove all grease, oil, dirt, etc. prior to carrying out insulation work.
- One coat Adhesive must be allowed to tack on the surface of the ducts to dry and then press surface firmly together starting from one end and working towards centre.
- Measurement of surface dimensions shall be taken properly to cut Oxide Acetate Foam sheets to size with sufficient allowance in dimension.



- Material shall be fitted under compression and no stretching of material should be allowed.
- A thin film of adhesive shall be applied on the back of the insulating material sheet and then on to the metal surface.
- When adhesive is tack dry, insulating material sheet shall be placed in position and pressed firmly to achieve a good bond.
- All longitudinal and transverse joints shall be sealed as per manufacturer recommendations.
- The adhesive shall be strictly as recommended by the manufacturer.
- The detailed Application specifications are as per the manufacturer's recommendation.

**RECOMMENDED THICKNESS OF CROSS LINKED CLOSED CELL OXIDE ACETATE FOAM BASED UPON DUTY CONDITIONS FOR COASTAL AREAS**

Supply air duct (Line temperature : 14 Deg C)	Use 25 mm thickness
Return air duct (Line temperature : 22 Deg C)	Use 9 mm thickness

**RECOMMENDED THICKNESS OF CROSS LINKED CLOSED CELL OXIDE ACETATE FOAM BASED UPON DUTY CONDITIONS FOR NON-COASTAL AREAS**

Supply air duct (Line temperature : 14 Deg C)	Use 19 mm thickness
Return air duct (Line temperature : 22 Deg C)	Use 9 mm thickness
Supply Air Duct in Return Air Path (Line Temp. 14 Deg.C)	Use 9 mm thickness

**d. Acoustic Duct Lining**

Acoustic material for Duct Acoustic Lining basic material shall be open cell oxide acetate foam. The Thermal conductivity of Oxide acetate foam for air-conditioning application shall not exceed 0.029 W/m K at 0 deg C mean temperature and 0.35 W/mk at 27±2 Deg C and average Noise Reduction Coefficient (NRC=0.50 for 10mm, NRC =0.65 for 15mm and NRC =0.84 for 25mm thickness at frequency range from 125 Hz to 4000Hz ). The density of Acoustic material shall be between 30 to 60 kg/m<sup>3</sup>.

**The installation guideline for Acoustic Isolate Foam in Duct Acoustic Lining:**

- The inside duct surface should be cleaned with suitable solvents and rendered free from all physical and chemical impurities. Thoroughly clean the entire surface with denatured alcohol. This must be done for new sheet metal in order to remove the oil residue off the entire surface.
- The Use of retaining pins is not required when using Rubber based adhesive.

- Measure all sides of the duct, then adding 5 mm approximately to the measurement to ensure a compression fit, cut isolate foam accordingly.
- Using an adhesive roller or a short, stiff bristle brush, apply a thin, uniform coat of adhesive to both the isolate foam as well as to the metal duct surface. Be certain there is 100% coverage on both surfaces.
- Once the adhesive is tacky (finger nail test) the top piece should be adhered. Start at one edge of the duct & align the outside edge of the Acco foam down to the duct. Continue along, applying pressure to the entire length & press firmly. When approximately 90% adhered, align the opposite edge tightly against the duct & press firmly, then press balance of foam flat.
- This will ensure a tight compressed fit at the edges when all the Acco foam has been applied.
- Be certain to apply full, even pressure along the entire surface with your hands or a weighted roller for best adhesion.

**e. Exposed Duct Thermal Insulation**

Duct insulation shall be applied as follows:

- Apply hot bitumen 85/25 over the surface after cleaning the ducts.
- Rigid extruded polystyrene 50 mm thick insulation material to be fixed tightly to the surface with joints well butted and secured.
- Cover the insulation with 24 gauge x 19 mm GI wire mesh with necessary overlapping.
- Apply 2 layers of 1:3 sand cement plaster mixed with water proofing compound each of 10 mm thickness achieving smooth surface finish.
- Apply 2 coats of synthetic paint of approved shade.

**f. Exposed Roof Thermal Insulation**

- The Under Deck insulation basic material shall be cross linked closed cell Oxide Acetate Foam
- Insulation should be of minimum thickness as mention in the BOQ.
- The insulation material shall be with Factory pre-laminated Aluminium foil.
- Density of Material shall be between  $30 \pm 3 \text{ Kg/m}^3$ .
- Thermal conductivity of Oxide Acetate foam shall not exceed  $0.029 \text{ W/m.K}$  at mean temperature of  $0^\circ\text{C}$  and  $0.35 \text{ W/mk}$  at  $27 \pm 2 \text{ Deg C}$
- Insulation material shall be UV resistive, anti microbial and anti fungal with zero rating fungal growth as per ASTM –G -21
- Insulation material should not have any effect of acids and alkalis as per IS:9845-1998
- The insulation shall have fire performance such that it passes Class 1 as per BS476 Part 7 for surface spread of flame as per BS 476 and also pass Fire Propagation requirement as per BS476 Part 6 to meet the Class 'O'.
- Water vapour permeability shall be negligible as per DIN EN ISO : 12572 , i.e. Moisture Diffusion Resistance Factor or 'μ' value should be minimum
- The insulation material passes Smoke and Toxicity test as per (IMO Resolution MSC - 307 (88) (2010 FTP Code): Annex 1: Part 2
- Material shall be CFC/ HCFC free as per US EPA 5021 A(2014 ).

**Application**

Under-deck surface of ceiling shall be cleaned with brush to remove all dirt, cement etc. If the surface is uneven it should be made smooth prior to carry out Insulation work. A layer of rubber based adhesive (Zero flame , UL listed – Pedilite SR 998 or Magic 81-10) should be applied on the ceiling with help of brush so that all the pores are filled & surface becomes smooth & allow it to dry.

Insulation material sheet of specific size (1.5mtr x 2mtr ) & ceiling surface shall have all over adhesive coverage.

A thin film of adhesive shall be applied on the ceiling with brush & then on the plain side of the insulating material with brush/small piece of sheet metal having smooth edges. When adhesive is tack dry, insulating material sheet shall be placed in position, pressed firmly & no gap shall be left.

During installation avoid air bubbles. Always apply pressure while fixing the insulation sheet, this action will ensure maximum bond strength.

Insulation material shall be fixed under compression, no stretching of material shall be permitted.

Once insulation material sticks with ceiling, fastener shall be applied at gap of every 400 to 500 mm distance to provide the permanent fixing of insulation material with ceiling. To avoid the risk of screw head going right through the insulation material, insulation fixing washer of minimum 60 mm diameter shall be used.

**g. Fire Breaks in Insulation**

Fire breaks shall be provided in all ducts (for internal lining / External thermal insulation) after a run of 10 M (Centre to Centre). Fire breaks in insulation simply mean that there will be a discontinuity of the insulating material in form of a MS angle of a minimum of 50mmx50mm x 3mm size. At the interface of the MS angle and the insulating material, proper care of tucking in of the insulating material shall be taken, so as to prevent erosion.

**h. Preamble to Mode of Measurement**

**IS 655 / SMACNA (AS ASKED FOR IN THE BOQ) SHALL BE ADOPTED FOR THE CONSTRUCTION PROCEDURES/ SPECIFICATIONS IN DUE ESSENCE OF THESE GUIDELINES ALSO.**

- All equipment described hereafter, shall be in accordance with the specifications.
- All equipment shall be selected and installed for the lowest Operating noise level.
- Supply of various equipment shall include all expenses for correspondence with manufacturers, submission of shop drawings, documents and their approval by the Consulting Engineer, procurement of equipment, transportation, shipping, payment of all taxes and levies, storage, supply of equipment at the point of installation, furnishing all technical literature required, replacement of defective components, and warranty obligations for the individual equipment.
- Installation of various equipment shall include all material and labor associated with hoisting and lowering of equipment in position, insulation of the components and

vibration isolation as required, grouting and anchoring or suspension arrangements and all incidentals associated with the installation as per the specifications and manufacturer's recommendation.

- Vibration isolators as specified or as recommended by the manufacturer shall be installed with each component. Performance ratings, power consumption and power data for each component shall be verified at the time of testing and commissioning of the installation, against the data submitted with the tenders.
- Shop coats of paint that have become marred during shipment or erection shall be cleaned off with mineral spirit, wire brushed and spot primed over the affected areas, then coated with enamel paint to match the finish over the adjoining shop painted surfaces.
- Testing and commissioning shall include furnishing all labour, materials, equipments, instruments, and incidentals necessary for complete testing of each component as per the specifications and manufacturer's recommendations, submission of test results to the Consulting Engineer and obtaining their approval and submission of necessary documents and completion drawings.
- All ducts shall be fabricated and installed conforming to the relevant Indian standards, approved shop drawings and the specifications.
- Duct installation shall include fabricating and installing the ducts, splitter dampers, turning vanes, and distribution grids within the ducts in position, and providing, installing and making air tight all joints with slips, bonded felt insertions, nuts, bolts and screws as required. In addition multi-louvered manually adjustable dampers shall be provided in various branch ducts as required or shown on drawings for proper balancing of air flows.
- All registers and diffusers shall be provided with a soft continuous rubber gaskets between their periphery and the surface on which these have to be mounted.
- Registers and diffusers shall be given, at the factory, a rust resistant primer coat and enamel paint finish of approved color.
- After completion of the installation, the entire air distribution system shall be tested for air leaks and balanced in accordance with the specifications.

#### **i. Mode of Measurement**

The mode of measurement for the various item, unless otherwise specified, shall be as follows:

##### **Ducting**

- Payment for ducting shall be made on the basis of the external surface area of the ducting including all material and labor for installed duct.
- The rates per sq. ft. of the external surface shall include flanges, gaskets for joints, bolts and nuts, duct supports and hangers, vibration isolation pads or suspenders, flexible connection, inspection doors, dampers, turning vanes, and any other item which will be required to complete the duct installation except external insulation and acoustic lining.
- The external area shall be calculated by measuring the overall width and depth (including the corner joints) in the center of the duct section and overall length of each duct section from flange face in case of duct lengths with uniform cross section. Total area will be arrived at by adding up the areas of all duct sections.

- In case of taper pieces average width and depth will be worked out as follows;  
 $W1$  = Width of small cross section  $W2$  = Width of large cross section  
 $D1$  = Depth of small cross section  $D2$  = Depth of large cross section  
Average width =  $(W1 + W2)/2$   
Average Depth =  $(D1 + D2)/2$
- Width and depth in the case of taper pieces shall be measured at the edge of the collar of the flange for duct sections fitted with angle iron flanges, otherwise at the bottom of the flange where flanges are of duct sheet.
- For the circular pieces the diameter of the section mid-way between large and small diameters shall be measured and adopted as the mean diameter for calculating the surface at the taper piece.
- For the face length of taper piece shall be the mean of the lengths measured face to face from the centre of the width and depth flanges.
- Duct measurements for calculation of area shall be taken before application of insulation.
- For the special pieces like bends, branches, and tees etc. same principle of area measurement as for linear lengths shall be adopted except for bends and elbows, the length of which shall be the average of the lengths of inner and outer periphery along with curvature or angle of the piece.

#### **Duct Insulation**

This item is provided separately for various thickness and shall be paid for on area basis of un-insulated duct. The area of the duct to be insulated shall be measured before application of insulation.

### **4.0 VENTILATION SYSTEM & ASSOCIATED WORKS**

#### **4.1 PROPELLER FAN**

- a. Fans shall be of the ring-mounted type and the blades constructed from heavy gauge metal. An aerodynamically designed bell mouth constructed from heavy gauge metal shall be provided. The fan speed shall not exceed 1450RPM at 50Hz operation.
- b. Propeller fans shall be direct driven type, the motor either a single-phase capacitor start-run or a three-phase squirrel cage induction type. The motor shall have inbuilt inherent protection against overloading. Motor with shaded pole or centrifugal switch type is not acceptable
- c. Bearings shall be maintenance free permanently lubricated type. Fans shall be complete with wire guards. External grilles, fan chambers and volume control damper shall be provided where indicated in the specification drawings.

#### **4.2 IN-LINE CENTRIFUGAL DUCT FAN**

- a. Fan shall be of SISW, **backward** curved centrifugal, direct driven type.
- b. Casing shall be of Galvanized steel with Oven-baked epoxy coating. Impeller material shall be either Galvanized Steel or Glass Reinforced Polypropylene

- c. Motor shall be external rotor type for power supply 220~240V/50Hz/Single Phase.

#### 4.3 AXIAL FLOW FANS (DIRECT DRIVE)

- a. Fans shall be licensed to bear the AMCA Air and Sound Certified Ratings Seal.
- b. The test standard used shall be ANSI/AMCA 210-85, ANSI/ASHRAE Standard 51- 1985 “Laboratory.
- c. Method of Testing Fans for Rating” and AMCA 300 “Reverberant Room Method for Sound Testing of fans”.
- d. Casing shall be constructed of heavy gauge sheet steel. Casing shall be provided with hinged door enabling easy replacement of wheel, shaft and bearings. A small inspection door with handle and neoprene gasket shall also be provided. Casing shall have flanged connection on both ends for ducted applications. Support brackets for ceiling suspension shall be welded to the casing for connection to hanger bolts.  
Straightening vanes shall be aerodynamically designed for maximum efficiency by converting velocity pressure to static pressure potential and minimizing turbulence. Casing shall be de-rusted, cleaned, primed and finish coated with enamel paint.
- e. Motor shall be of 3 phase squirrel-cage totally enclosed, fan cooled type. Motor and starter shall be in accordance with applicable standards. The speed of fan shall be as per OEM. However it is desired that speed shall not exceed 1000 RPM for fans with impeller diameter above 450 mm, and 1450 RPM for fans with impeller diameter of 450 mm and less.
- f. Base shall be provided for each fan. Base for both fan and motor shall be built as an integral part and shall be mounted on a concrete foundation through cushy foot vibration isolators. The concrete foundations shall be at least 15 cm above the finished floor level and shall be further isolated from the structural floor through 5 cm. Thick layers of sand all around, topped with bitumen. In case ceiling hung fan within the ceiling shall be provided Vibration Isolation Suspension (VIS) shall be provided in each of string.
- g. Fans shall be oven-baked with polyester coating for minimum thickness of 60 microns or hot-dipped galvanized.
- h. Fan motor base support shall be properly secured (locked and sealed) to the fan housing and be of adjustable type to have precise control of motor shaft central position as well as running clearance between blade tips and casing.
- i. Fans supplied shall be complete with factory fabricated mounting bracket (ceiling or foot mounted) and suction/discharge matching flanges as accessories.
- j. All hubs shall be cast Aluminium alloy (Grade LM2) unless for Smoke spill Fans where high temperature (250°C, 2.0 Hr. Fire Duty) air is expected then Aluminum alloy or steel fan impeller blades are required. Otherwise impeller blade material with Polypropylene (PP), Glass-reinforced Polypropylene (PPG) and Glass-reinforced Polyamid (PAG), to provide self-balancing, anti-static, anti-sparking characteristic is preferable. Fan blade mounting on the hub shall be statically and dynamically balanced. Extended grease leads for external lubrication shall be provided.
- k. Running clearance between blade tips and casing shall not exceed 1% of the impeller diameter, and 2% for smoke spill high temperature fan where mechanical expansion coefficient is different from normal ambient temperature. Fan manufacturer shall provide the fan assembled with the same clearance between blade tips and casing of the tested prototype. Note that the air performance and pressure loss are greatly affected by this clearance.
- l. Impellers shall be secured to the drive shaft by a key and keyway. Axial location shall be

provided by a collar or shoulder on the drive shaft together with a retaining washer and screw fitted into a tapped hole at the end of the shaft and locked in position. Blades shall be secured in place to the angle setting by setscrews, locking nuts or setting pins.

#### **4.4 AIR WASHER–PACKAGED TYPE**

##### **4.4.1 Scope of Work**

Supply, installation, testing and commissioning of packaged type air washer as per specifications. Manufacturer' product data for review shall be supplied for certified pump curves showing pump performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable.

##### **4.4.2 General Requirements**

- a. Statically and dynamically balance rotating parts
- b. Construction to permit complete servicing without breaking any connections
- c. Provide flanged pump connections
- d. Provide mono–block pumps/submersible and strainers of adequate capacity.

##### **4.4.3 General**

The Evaporative Cooling Machine will be self contained and will consist of the following component parts listed in the following paragraphs. The entire unit shall be WEATHER PROOFED and Highly CORROSION PROTECTED with 18 Ga SS 304 with FRP lining shall be provided to all the sections or automotive paint, as hereinafter specified. The unit shall have a horizontal submersible/monoblock self priming pump assembly to provide recirculate tank water and a pressurized flow via a piping system for proper pad (Munter) and media water distribution. The unit shall be factory fabricated.

##### **4.4.5 Blower Section**

The blower section shall include Centrifugal Forward Curved DIDW fan wheel of totally GI Construction with Inlet Cones and shall be complete with individual motor and drive and shall be mounted C Channel frame and Cushy Foot Mounts or as per OEM standard. The fan shall have a capacity not less than the one specified in the catalogues and shall be constructed and rated based on delivery against the rated static pressure with the media and filters in place. The fan will be of riveted construction and made with GI sheet of required thickness. The fan wheel will be of the multiblade type and mounted on two self aligning pillow block bearings of the requisite size. The fan shall be run with the help of “V” Groove drives as per the recommendation of the drive supplier. The blower housing will of the pittsburg joint construction and the drive will be provided by a motor of adequate capacity. The motor plate will be constructed out of 12 Ga MS or heavier metal with slotted holes which permit belt adjustment in both the directions. The material used will be 16 Ga GI. The outlet velocity of the blowers will be kept low.

#### **4.4.6 Evaporative Section**

The wet section will have 16 Ga GI Tank with folded construction with the bolted openable sides in 16 Ga GI sheet. The section will be of welded construction. 300 mm thick Cooling pads (Munter) will be provided designed @ 2.5 m/s to give 90% adiabatic efficiency. 2mm thick FRP specially fabricated header will be provided for the water distribution using 20 mm PVC perforated piping. All wet sections will include 5 layer 30 micron Aluminum Wire mesh filters of 50 mm thickness including the mounting channels for the same. 15 mm Brass Bleed off cock, 20 mm heavy duty Brass Float. PVC drain/overflow and bleed off outlet are standard on all wet sections.

18 Ga SS 304 with FRP lining shall be provided to all the sections or automotive paint.

Double/Single skin construction similar to air handlers (except for internal sheet which shall be SS 304 with FRP lining/automotive steel) shall be provided. If double skin than Panel will be 43+/-2 mm thick. Wherever exposed to atmosphere., otherwise the panel thickness shall be 23 +/-2 mm thick.

### **4.5 AIR SCRUBBER DRY TYPE (KITCHEN SCRUBBER)**

#### **4.5.1 Scope of Work**

The specification for package type dry scrubber for kitchen exhaust covers the design requirement, constructional feature, supply, installation, testing & commissioning. It shall have electrostatic air cleaner, Activated Carbon Filter Bank Unit as Odor Absorber Section, Automatic Wash Unit & Detergent Tank as specified in the BOQ. Odor Absorber Section.

#### **4.5.2 Type**

The unit shall be modular in construction and shall have individual sections of inlet, pre- filter, Dust collector section. Unit shall be supplied with control panel and one point wiring.

#### **4.5.3 Principle of Operation**

The pre-filter shall remove of large grease particles. The electronic filter shall remove the smaller grease and smoke particles. The principle of operation shall be based on electrostatic deposition. The particle shall pass by an ionizing wire, which will induce a positive charge on the particle. The particle then shall pass between closely spaced aluminum plates, which are held at a positive charge and a ground. As the charged particle travels between the two aluminum plates it shall be forced away from the plate held at the identical polarity and drawn towards the grounded plate. Once attached the particle shall remain on the plate until cleaned off during washing.

#### **4.5.4 Equipment Specification**



The air filtration system shall be a modular system. Multiple units can be joined together for increased volume. The system shall be a single pass. Particulate filtration efficiency shall be evaluated on the basis of ASHRAE 52-72 & DOP Test Method. The specified unit shall have demonstrated a removal efficiency of at least 95% and above. Ozone Generation concentration shall not exceed 0.05 PPM.

#### **4.5.5 Housing**

Housing shall be 16 gauge (1.6mm) Electro galvanized steel with powder coat / PU paint finish construction. Each section shall include single door access, located on one side of the unit. The access door shall be mounted on hinges and secured with appropriate arrangement allowing for component access and removal. All doors shall be gasketed to prevent air and water leakage. High voltage contacts on the housing shall be made of appropriate material like phosphor/bronze etc. Enclosure for electrical components shall be included to prevent leaks to the power supply. Unit shall have flanges / collar on the inlet and outlet for connecting ductwork. Unit shall be provided with appropriate drainage arrangement. Electrical contacts shall be in the door for ease of maintenance. Each unit shall have track guides for proper alignment of cell, making it possible to change the direction of airflow by reversing the orientation of electronic collector cell(s).

#### **4.5.6 Finish**

The external casing finish shall be a durable industrial grade semi gloss Baked on epoxy ester / PVC / Nylon, not less than 3-mil minimum thickness or PU paint finish with same thickness. The pre-filter shall be Washable type Honeycomb filters of Aluminum mesh are used to optimally remove larger particles of grease and dust before the main filter and shall be secured in stainless steel frame. Face of each prefilter shall be min 2.75 square feet.

#### **4.5.7 Pre-filter**

Access to the prefilter shall be from the side through the same hinged door to gain access to the electronic cells. Separator section shall be designed for an equal airflow across the entire Air cleaning unit.

#### **4.5.8 Electronic Cells**

Electronic cells described in this section refer to a full size cell. Half size shall not be acceptable. Ionizing-Collecting cell shall be of one-piece construction min 254 mm deep in direction of airflow. Face area of each cell shall be min 0.24 square meters and the effective collecting area min 44 square feet (4.1 square meters). Frame- All support framing, end plates and ionizer ground electrodes shall be 0.080-inch (2.03-mm) thick stainless steel 316 and the distance between each plate should not be more than 7 mm. Handle shall be located on the side of the cell for removal of the cell from the air cleaner. The handle shall be grounded to the frame of the cell. Contacts shall be made of any suitable material like phosphor bronze or eq. on the front of the cell. They shall make contact with the ionizing, collector and ground sections of the cell.

**4.5.9 Ionizer Section**

Ionizing wires shall be minimum of 8 per electronic cell, with a length of min 15.35 inches (390 mm) each. Ionizing wires shall be constructed of 0.010 inches diameter (0.25 mm) Tungsten for prevention of corroding or breaking. Wires shall be fixed at one end and spring mounted on the other for ease of maintenance. There shall be min 7 grounding plates between the wires stabilize the ionization field for better performance. Grounding plates shall be no greater than 1.89 inches (48 mm) apart, and 0.07 inches (1.8 mm) thick. Insulators for the Ionizer shall be made of Teflon.

**4.5.10 Collector Section**

Grounding plates shall be a minimum of 0.02 inches (0.5 mm) thick aluminum. The plates shall be 9.65 inches (245 mm) deep in the direction of airflow.

Grounding plates shall be a minimum of 23 quantities per cell. Spacing between grounding plates shall be at 0.67 inches (17 mm). Spacing between the grounding plates and the charged plates shall be at not more than 7 mm. Charged plates shall be a minimum of 0.02 inches (0.5 mm) thick of Stainless Steel 316. The plates shall be 7.68 inches (195 mm) deep in the direction of airflow. Separator rods shall be made of Stainless Steel 316 with notches to hold the ground and charged plates apart at given lengths. Rods shall be 0.47 inches (12 mm) in diameter. The separator rods shall run the length of the cell to the frame of the cell. There shall be at least 12 rods total per cell. Insulators for the collector shall be made of PTFE (Teflon). Markings shall be on the cell to inform indicating direction of the airflow.

**4.5.11 Power Supply**

Power supply shall be of a 100% solid state type. Power supply shall be mounted within the air cleaner out of the air stream. Input voltage shall be 220 Volt, 50 HZ, 1 phase. Output High frequency with built in short circuit and arc protection, providing a dual high voltage output of (+) 12 KVDC for the ionizer and (+) 6 KVDC for the collector. The Power Supply shall be of capable of min 120 watts and 10 mA. The power supply shall operate over a temperature range of -20 to 140 degrees F (-38 to 85 degrees C).

**4.5.12 Fan**

The blower shall be Centrifugal Backward Curved DIDW fan wheel of totally GI Construction with Inlet Cones and shall be complete with individual motor and drive and shall be mounted on C Channel frame and Cushy Foot or Spring Mounts. Each Scrubber shall comprise of one / two no. fans to handle air quantities as stipulated in BOQ. Each fan shall be driven by suitable HP TEFC motor. The fan wheel will be of the multiblade type and mounted on two self-aligning pillow block bearings of the requisite size. The fan shall be run with the help of "V" Groove drives as per the recommendation of the drive supplier.

**4.5.13 Motor**

The TEFC motor shall be suitable for  $415 \pm 10\%$  volts, 3 phase, 50 Hz  $\pm 5\%$ , A.C supply. The motor shall be with class B/E insulation confirming to IS 325. The motor speed shall be 1440 RPM maximum designed and guaranteed for continuous operation at the nameplate rating. It should confirm to IP 55.

#### **4.5.14 Installation**

The fans, scrubber etc. shall be provided with necessary vibration isolation cushy foot mounts. All necessary accessories such as nut bolts etc. shall be arranged by the contractor. The contractor shall arrange his own labour with material for completion of assembly.

The contractor, if specifically specified in bill of quantities, shall cast the RCC foundations for equipment. Anti-vibration pads of adequate efficiency shall be provided.

#### **4.5.15 Testing**

The AC contractor shall compute the unit air quantity with the help of velocity meter. The computed results shall be tallied with specified capacities and power consumption shall be tallied with the indicated figures in the technical data furnished with the bid by the contractor.

All necessary instruments of proper accuracy and services needed for the tests required for the computation of capacities and power consumption as required by the Engineer shall be provided by the contractor at his own cost.

It shall also be the responsibility of the Contractor to supply the motors and starters to satisfy the local regulations pertaining to the limitation of starting current and indemnify the Department from all liabilities arising out of any objections raised by the local authorities in this regard.

#### **4.6 Air Curtain**

- a. Air curtains shall be AMCA certified models.
- b. They must meet ASHRAE Standard 90.1-2019 and the NBC code.
- c. Air curtains shall help promote the perfect environment whether warm, cool or ambient.
- d. Air curtains shall promote open door trading in building and provides uninterrupted access for passing trade.
- e. Air curtains shall over open doors promote significant energy savings.
- f. Air curtains shall help to ensure a clean and healthy environment.
- g. Air curtains shall be easy to install and also easy to maintain throughout their serviceable life.

#### **4.6 VENTILATION FANS**

The contractor shall supply install, test and commission ventilation fans wherever shown on the drawings and as scheduled. The system shall be complete in all respects and comply with the specification given.

- a. Fans shall be of the type, size, arrangement and capacity as indicated in the schedule and/or as shown on the drawings
- b. Unless specified, fans performance rating data shall be tested accordance with AMCA Standard 210-85 (Air Moving and Conditioning Association), ANSI/ASHRAE Standard 51-1985 "Laboratory Methods of Testing Fans for Rating". Sound ratings shall conform to AMCA Standard 300-85, "Reverberant Room Method for Sound Testing of Fans"
- c. A computer printout of fan performance rating corresponding to the AMCA licensed data, with corrected ratings for altitude and temperature, fan operating speed, bearing life, etc. shall be submitted for approval.
- d. All fans shall be dynamically trim-balanced to ISO1940 and AMCA 204/3 - G2.5 quality

grade after assembly. A computer printout with the vibration spectrum analysis shall be attached to the fans.

- e. Fan motors shall comply in all respects with continuous rating in accordance with IEC34 or equivalent. Motor bearings shall be of ball or roller type, grease or lubricant sealed for life. Fan and drive shall be earthed to prevent accumulation of static charge.
- f. Kitchen exhaust fan shall be of bifurcated axial or SISW centrifugal direct or belt driven type. DIDW centrifugal and direct drive axial flow fan where belts or motor are in the air stream are not acceptable.
- g. Fans for elevated temperature (smoke spill duty) with components rated for high temperature (250°C, 2.0 hrs duty, tested and certified by any independent international fire laboratory, certificate of conformity shall be provided for the same) service shall be provided.

#### 4.7 CENTRIFUGAL FANS

- a. Fans, forward or **backward** curved, SISW or DIDW, shall be licensed to bear the AMCA Air and Sound Certified Ratings Seal. The test standard used shall be ANSI/AMCA 210-85, ANSI/ASHRAE Standard 51- 1985 “Laboratory Method of Testing Fans for Rating” and AMCA 300 “Reverberant Room Method for Sound Testing of fans”.
- b. All fans shall be dynamically trim-balanced to ISO1940 and AMCA 204/3 - G2.5 quality grade after assembly.
- c. Fans shall be oven-baked with polyester coating for minimum thickness of 60 microns, unless the housing scroll and side frame is constructed from galvanized steel sheet (G.I), Stainless Steel, Aluminum and etc.
- d. Fans must be physically capable of operating safely at every point of rating at or below the “minimum performance” limit for that class as defined in AMCA standard 99-2408-69 “Performance Class of Operating Limits for Centrifugal Fans”.
- e. Shafts shall be made of carbon steel (C45) machined and polished to tolerance of standard ISO 286–2–grade g6. Protective coat of anti-rusting shall be applied to all bare surfaces of the shafts at the factory.
- f. Bearings shall be of self-alignment (concentric) type with adaptor sleeve bearing. Bearings of eccentric locking collar with grub screw type are not acceptable. Bearing shall be maintenance free with permanently lubricated sealed ball bearing type. Bearing life shall be at least 75,000 hours based on basic rating life, L10 of ISO 281 standard. Calculation sheet of Bearing Life shall be submitted for approval.
- g. Motor installed shall be of a minimum 130% of the fan power absorbed (Brake horsepower) and shall have sufficient torque available for starting and continuous operation.
- h. Belts and pulleys shall be sized for a minimum 150% of the installed motor horsepower. The belt speed shall not exceed 30m/s. The pulley shall be of Taper Lock SPZ, SPA, SPB or SPC type. Conventional type of pulley is not acceptable. Both fan and motor pulley shall be balanced to the quality grade G2.5.

#### 4.8 VENTILATION UNITS (FAN SECTIONS)

- a. The scope of this section, comprises the supply, erection, testing and commissioning of double / single skin construction Ventilation units, conforming of these specifications and in accordance with requirements of Drawings & of the Schedule of Quantities.
- b. The Ventilation units shall be double /single skin construction, draw–thru type comprising of various sections such as plenum chamber (wherever the Exhaust Air is ducted ) filter

section and filter, fan section as per details given in Drawings and Schedule of Quantity.

#### **4.8.1 Capacity**

The air handling capacities, maximum motor H. P., static pressure shall be as shown on Drawing and in Schedule of Quantity

#### **4.8.2 Housing / Casing (Single Skin)**

The housing/casing of the air handling unit shall be of Double skin construction. The Frame work shall be of Extruded Aluminum hollow sections.

Frame work for each section shall be jointed together with soft rubber gasket in between to make the joints air tight. Suitable air tight access doors/panels with Nylon hinges and locks shall be provided for access to various sections for maintenance. The entire housing shall be mounted on Rolled Formed GSS channel frame work .

#### **4.8.3 Motor and Drive**

Fan motors shall be 415 for 10% volts, 50 cycles, 3 phase, squirrel- cage, totally enclosed fan cooled with IP - 55 protection. Motor shall be especially designed for quiet operation and motor speed shall not exceed 1440 RPM. Drive to fan shall be provided through belt-drive arrangement. Belts shall be of the oil-resistant type.

#### **4.8.4 Fan**

The fan shall be **backward** curved, double inlet double width type. The wheel & housing shall be fabricated from heavy gauge galvanised steel. The fan impeller shall be mounted on a solid shaft supported to housing with angle iron frame & pillow block heavy duty ball bearings.

The fan shall be selected for a noise level less than 80 db (A). The impeller & fan shaft shall be statically and dynamically balanced. The Fan outlet velocity shall not be more than 10.0 Meter/Sec. Fan housing with motor shall be mounted on a common base mounted in side the air handling housing on anti-vibration mounts. The fan outlet shall be connected to casing with the help of fire retardant fabric acting as a flexible connection for anti-vibration.

#### **4.8.5 Filters**

Each unit shall be provided with a factory assembled filter section containing washable synthetic type air filters having extruded aluminium frame as specified in BOQ. The media shall be supported with HDP mesh on one side and aluminium mesh on other side. Filters face velocity shall not exceed 150 meters per minute. Filter shall fit so as to prevent by pass. Whenever fine filter are required to be installed, unit shall be provided with factory fabricated plenum chamber in double skin construction as described above for casing specification. The fine filter shall incorporate pocket filters which will have an efficiency of not less than 95% by ASHRAE standard corresponding to Eurovent standard EU-5.

#### **4.8.6 Safety Features**

Each Ventilation Unit must have safety features as under:

- a. The Fan Access Door shall be equipped with micro-switch inter locked with fan motor to enable switching off the fan motor automatically in the event of door opening.
- b. The Access Door shall further have wire mesh screen as an added safety feature bolted on to the unit frame.
- c. Fan and motor base shall be properly earthed from the factory
- d. All screws used for panel fixing and projecting inside the unit shall be covered with PVC caps to avoid human injury.

#### **4.8.7 Performance Data**

Ventilation units shall be selected for the lowest operating noise level of the equipment. Fan performance rating and power consumption data, with operating points clearly indicating shall be submitted and verified at the time of testing commissioning of the installation.

#### **4.8.8 Testing**

Air-flow measurements shall be made by an anemometer and computed results shall conform to the specified capacities and quoted ratings. Power consumption shall be computed from measurements of incoming voltage and input current.

### **5.0 ELECTRICAL ITEMS**

This section deals with supply, installation, testing & commissioning of Motor Control Center (MV panel) & shall be manufactured by CPRI approved vendors. The power / control cabling & earthing work shall be carried out as per the specification given below:

#### **5.1 SCOPE**

All work shall conform to Indian Electricity Act (amended up to date), I.S. code of practices local rules and regulations etc. Power cabling shall be carried out with approved make of cables as indicated in the **List of approved make of equipment / materials** and shall be of grade 1100 volts, PVC insulated & sheathed, armored aluminum conductors cables. Control cabling shall be of approved make and shall be of grade 1100 volts, PVC insulated & sheathed, copper conductor armoured multicore cables as specified in B.O.Q

#### **5.2 MOTOR CONTROL CENTER (MV PANEL)**

Motor control center (MV Panel) floor mounted extendable type & wall mounted AHU sub-panel shall be fabricated out of 14G C.R.C.A. Sheet. These panels shall be cubical sectionalized type, totally enclosed dust & vermin proof. Gaskets shall be provided in all joints to prevent dust to reach the internals of the panels to make it completely dust proof. The degree of protections for panels shall be IP 52 for indoor applications and IP 55 for outdoor applications as per IS:2147.

These panel (MV) shall be suitable for voltages up to 500 volts, three phase 50 Hz, 4 wire supply capable of functioning satisfactorily in temperature ranging up to 45 to 50 degree centigrade and rupturing capacity suitable for connected load & design should be type tested for 42 KA fault level.

All joints of panels shall be welded and braced as necessary to provide a rigid support for all components. The base channel provided in the floor mounted MV panel shall be 75mm high & a clear space of 200mm between the floor and the bottom most part of the unit shall be provided. The panel shall be correctly positioned. Self- threading screws shall not be used in the construction of control panels. Appropriate knock-out holes of proper sizes shall be provided for incoming and outgoing cables. The facility for bottom or top entry of cables in the panels shall be provided. Necessary cables clamps shall be provided for holding the cables in position.

All power/control wiring inside the panel shall be color coded and control wiring ferruled for identification purpose. All labeling shall be provided in engraved anodized aluminum strips on the front face of the panel.

Each circuit breaker shall be housed in separate compartments. It shall have steel sheets on top and bottom of compartment. The steel sheet hinged door shall be interlocked with the circuit breaker on the "ON" position. When the breaker is on the "ON" position, suitable preventive measures shall be provided, such as interlocks, to prevent the breaker from being drawn out. When the breaker is in "ON" position steel sheet shall be provided between the tiers in the vertical section. The door of this compartment shall not form part of the draw out arrangements.

### **5.2.1 BUS-BARS**

The bus-bar and its connections shall be Copper Electrolytic grade and shall be of rectangular section. The amperage capacity of Copper bus bar shall 1.25A / Sq. mm. These should be suitable for full load current for phase bus-bar and neutral bus-bar shall be of half rated current capacity. The bus-bar should have provision on either side for extension. The bus-bar should be sleeved with color coded heat shrinkable PVC sleeve. Bus-bar supports shall be of fibre glass reinforced thermosetting polyester having in built and tracking barriers to break the path of conducting dust through molded ribs.

In panels bus-bar connections shall be done by drilling holes with cadmium coated bolts and nuts. Extra cross section shall be provided to compensate drilling of the holes. Insulated aluminum strips of suitable size of full rated current capacity shall be used for interconnecting bus-bar and breaker.

A horizontal / vertical wire way shall be provided for interconnecting control wiring between different vertical sections.

The terminal blocks shall be used for outgoing terminals and neutral link at a suitable located place in the control panel. Separate compartments for outgoing and incoming cable shall be provided. The current transformers of all instruments shall be mounted with terminal blocks.

All live parts including incoming and outgoing link / terminals should be totally shrouded by means of non-hygroscopic and fire retardant material.

### **5.4 ROTARY SWITCH / SELECTOR SWITCH / SWITCHES / HRC FUSES / STARTERS / SINGLE PHASE PREVENTERS / TOGGLE SWITCH.**

These shall be of approved make and conforming to relevant ISI standard. The rupturing capacity of HRC fuses should not less than 80 KA and in case of switches it should be 60 Amps maximum.

### **5.5 CURRENT TRANSFORMER**

The current transformers shall have accuracy of class I and 5P10 / 10P10 and suitable VA burden for operation of the connected meters and relays.

### **5.6 OVERLOAD RELAYS**

All the motors shall have overload relay protections conforming to relevant IS.

#### **5.7 TIME DELAY RELAYS**

These shall be adjustable type with time delay adjustments of 0-180 or as per manufacturer's standards.

#### **5.8 INDICATING LAMPS AND METERING**

These shall conform to BS37 & BS39. All meters shall be flush mounted and draw-out type. The indicating lamp shall be LED type.

#### **5.9 MULTI FUNCTION METER**

Motor Control Center (MV Panel) shall have flush type MFM of class 1.0 as detailed in B.O.Q.

#### **5.10 PUSH BUTTON STATIONS**

These shall be suitable for panel mounting and accessible from front without opening. These shall be provided for manual starting and stopping of motors/equipment as per normal practices. The contacts shall be suitable for 6A current capacity.

#### **5.11 CONDUITS**

These shall be preferable made of mild steel, stove enameled from inside and outside with minimum wall thickness of 1.6 mm for conduits up to dia of 25mm and 2 mm for conduits above 25 mm diameter.

#### **5.12 CABLES**

These shall be PVC insulated, pre-sheathed, copper conductor armored cables as per IS:694 and as per **list of approved make of equipment / materials**. Control Cables shall be multi-core PVC-insulated PVC sheathed copper conductor and armoured cables of approved make only.

#### **5.13 LAYING OF CABLES**

These shall be laid as per Indian Standard code of practice. All cables shall be laid on existing cable trays. In case more than one cable is running, then proper space in between the two cables shall be provided to avoid loss of current carrying capacity. While cables are running on walls, proper saddles must be provided. Necessary accessories like cable termination Glands, requisite size Lugs and Ferrules for proper cable connection shall be provided.

#### **5.14 WIRE SIZES**

Single stand PVC-copper conductor wires shall be used inside the control panel for interconnecting different components. All wires shall be neatly dressed and colored beads shall be provided for easy identification in control wiring. The minimum size of control wiring shall be 1.5 sq.mm, each HVAC ODU shall be given power supply through 16 sqmmX4C copper cable (by laying new cable)



and each AHU shall be provided with a newly laid 6 sqmmX4C copper cable. Testing of panels as per code of practice shall be done at works by AC contractor before inspection & dispatch to site.

### **5.15 DRAWINGS**

Necessary drawings of all control panels and wiring of equipment etc., shall be submitted by the A.C contractor for approval of the Engineer in Charge. On final completion of job and before handing over of AC System As Built Drawings shall be submitted to the Department.

### **5.16 TESTING**

The complete electrical installation shall be tested in accordance with relevant ISI codes in presence of Electrical Supervisor of the Department before commissioning of plant.

### **5.17 PAINTING OF PANELS**

All sheet metal enclosures shall be powder coated only after de-rusting & hot-dip phosphate degreasing etc. at works only.

DFCCIL shall provide 3-phase 415V, 50Hz power at a single point ((ie. Sub-AC panel on terrace) for all VRF outdoor units. The tenderer shall lay all required XLPE armored cables, cable trays, necessary protection to connect all equipment on rooftop including VRF Outdoor Units from Sub AC Panel to ODUs. Electrical connections to individual IDUs shall be carried out with FRLS cables from DB on each floor.

### **5.18 CAPACITY OF RELAYS AND CONTACTS**

The following capacity relays and contacts shall be used for various rating of motors:

a)50/60 HP Motor	Star Delta Starter	65 Amp.	30 - 50 Amp.
b)40 HP Motor	Star Delta Starter	45 Amp.	20-33 Amp.
c)30 HP Motor	Star Delta Starter	45 Amp.	20-33 Amp.
d)25 HP Motor	Star Delta Starter	32 Amp.	14-23 Amp.
e)20 HP Motor	Star Delta Starter	32 Amp.	14-23 Amp.
f)15 HP Motor	Star Delta Starter	25 Amp.	9-15 Amp.
g) 10 HP Motor	Star Delta Starter	16 Amp.	6-10 Amp.
h) 7.5 HP Motor	D.O.L. Starter	16 Amp.	9-15 Amp.
i) 5 HP Motor	D.O.L. Starter	16 Amp.	6-10 Amp.

### **5.19 EARTHING**

System shall be complete with electrical panel board with cabling & earthing. The earthing of all equipments shall be carried out by Copper strips / wires. All panels / three phase motors shall be earthed with two number distinct and independent Copper strips / wires. HVAC ODU modules & AHU units shall be provided with 8 SWG GI wire for body earthing (double earthing to be provided). The earthing connections shall be connected to main earth station or main earth grid. The earth connections shall be connected to equipment's after removal of paint, grease etc.

The earthing of all equipment's shall be carried out by Copper strips / wires. All HVAC ODUS's and F.A.H.U's shall be provided with two different visible G.I Earthing wires of 8 SWG and the same wires shall be connected to the nearby earthing grid/mesh available. All panels / three phase motors shall be earthed with two number distinct and independent Copper strips / wires of the following sizes:

1.Motor upto 5.5 KW	3 sq. mm Copper Wire
2.Motor 7.5 to 12 KW	4 sq. mm Copper Wire
3.Motor 12 to 50 KW	25x3 mm Copper Strip
4.Motor 51 to 89 KW	32x6 mm Copper Strip

The earthing connections shall be connected to main earth station or main earth grid. The earth connections shall be connected to equipment's after removal of paint, grease etc.

## **6.0 INSPECTION, TESTING AND COMMISSIONING**

### **6.1 SCOPE**

This scope covers initial inspection and testing of VRV/VRF system & AHUs at manufacturer's works, initial inspection of other equipments/ materials on receipt at site, final inspection testing & commissioning of all equipment at site & description of testing requirements & procedure.

## **7.2 INITIAL INSPECTION AT MANUFACTURER'S WORKS**

### **7.2.1 Scroll Compressor**

- a) Salient features such as model, capacity control, type of lubrication etc. shall be verified against the requirements visually without opening the compressors.
- b) Manufacturer's internal test certificates shall be scrutinised to check compliance with the requirements as specified in the contract.
- c) Free running test shall be carried out at the speed for which the motor is available with manufacturer but the speed shall not be less than that specified in contract. This test shall be carried out for 30 minutes in open space. During this running test following operations are to be noted :
  - a) Manual operation of capacity control
  - b) Lubrication oil pressure

### **7.2.2 Condenser**

- a) Salient features like number of tubes, inside diameter of tubes (from which the gauge of the tube can be verified), no. of passes, material of fins, length of condenser, provision of fittings like safety valve, water, gas connection shall be verified during stage inspection. The tube thickness shall be checked.
- b) Manufacturer's internal test certificates shall be furnished and it shall be verified against contract requirements.

### 7.3 Factory Testing:

The complete unit shall be factory tested at 25%, 50%, 75% and 100% capacity and witnessed by *Representatives of the Engineer or as given in bid document* for performance at the rated conditions by simulating the actual design conditions. One unit of each capacity shall be tested.

All controls and switchgear shall be tested for proper functioning and set of design values. The capacity in TR / kcal/hr shall be calculated from measurements. The power consumption shall be checked from current measurement of the motor. All calculated and checked results shall match the specified data within tolerances as stipulated by ARI.

All instruments and personnel for tests shall be provided by the contractor. Contractor shall inform the client about the testing schedule min. 10 to 15 days before the machine is ready for factory testing.

### 7.4 Air Handling Units :

- a) Salient features such as model, size, physical dimensions, and other details of various sections, fan motor details, fan dia, static pressure etc. shall be verified against the contract requirements.
- b) Manufacturer's internal test certificates for the motor and air handling unit shall be furnished and scrutinized as per contract requirements.
- c) Test certificate for static and dynamic balancing of the fan/ blower should be furnished. Fan balancing may be witnessed by Engineer-in- Charge or his authorized representative.
- d) Salient features like, type, material, no. and gauge of fins and tubes and no. of rows of cooling coil shall be furnished and verified with reference to contract requirements during stage inspection.
- e) Hydraulic pressure to the extent of 10 Kgf/sq.cm or pneumatic pressure of 21 kgf/ sq.cm shall be applied to cooling coil and this pressure should be maintained for 1 hour and no drop should be observed indicating any leaks.

### 7.5 INITIAL INSPECTION AT SITE

#### 7.5.1 Ducting:

- a) The sheet used for ducting shall be checked for physical test at site. The physical test should

include the sheet thickness and bend test as per relevant IS specifications.

- b) Zinc coating of GSS sheet as mentioned in the tender documents may be got tested from a laboratory to verify that same meets the contract requirements.

### **7.5.2 Switch Gear, Control Gear, and Measuring Instruments**

These should be of specified make. For air circuit breaker manufacturer's test certificate shall be furnished by contractor and the same shall be verified as per contract requirements.

### **7.5.3 Electric Motors**

Electric motors should be of specified make, manufacturer's test certificate for electric motor shall be furnished.

### **7.5.4 Refrigerant Pipes**

- a) It should be checked that the same is as per makes specified in contract.
- b) Dimensions shall be checked for pipes against the requirements of contract.
- c) Insulation and acoustic lining
- d) Physical verification for thickness and make should be made as per contract before application of insulation.
- e) Manufacturer's test certificate for density, thermal conductivity, sound absorption and class of fire retardation wherever applicable should be furnished.

Note: Accuracy of testing instruments shall be as mentioned in the final inspection procedure.

## **7.6 FINAL INSPECTION**

- i) After completion of the entire installation as per specification in all respects, the AC contractor shall demonstrate trouble free running of the AC equipments and installation for a period of minimum 120 hours of running. The plan will be said to have successfully completed the running-in period, if no breakdown or abnormal/unsatisfactory operation of any machinery occurs during this period.
- ii) The equipment capacity computations shall be carried out to verify the Tender Document requirements.
- iii) The Input KW of the unit / TR at full load shall also be checked against contract requirements, if any.
- iv) All instruments for testing shall be provided by the AC contractor . The accuracy of the instruments shall be as follows:
  - a. Temperature: Liquid in glass thermometer having accuracy  $\pm 1$  deg. C as per IS: 4825.

- b. Wet bulb Temperature : Sling psychrometer conforming to IS:6017.

Scale Error:

For less than 0 deg. C :  $0.3 \text{ deg. C} \pm 0.2 \text{ deg. C}$ . For over 0 deg. C :  
 $0.2 \text{ deg. C} \pm 0.1 \text{ deg. C}$ .

- c. Pressure Gauge: With the accuracy of  $\pm 1\%$  for maximum scale value from 10 to 90%, and  $\pm 1.9\%$  for maximum scale value for rest of the scale conforming to IS: 3695.

## 7.7 TESTING REQUIREMENTS AND PROCEDURES

- 7.7.1** Balancing of all air and water systems and all tests as called for in the specification shall be carried out by the HVAC contractor in accordance with the specifications and relevant local codes if any. Performance tests of individual equipment and control shall be carried out as per manufacturer's recommendation. All tests and balancing shall be carried out in the presence of Engineer-in-charge or his authorized representative.

The whole system balancing shall be tested with microprocessor based hi-tech instruments with an accuracy  $\pm 0.5\%$ .

The instrument shall be capable of storing data and then down loading into a P.C. The HVAC contractor shall provide a minimum but not limited to the following instruments:

- i) Microprocessor based calculation meter to measure DB and WB temperature, RH and Dew point
- ii) Velo meter to measure air volume and air velocity
- iii) Pitot tube
- iv) Electronic rotary vane Anemometer
- v) Accubalance flow measuring hood

The contractor shall be responsible to provide necessary sockets and connections for fixing of the testing instruments, probes etc.

### 7.7.2 Air Systems:

Systems are to be balanced by first adjusting the total flow at the fan, then by adjusting main dampers and branch dampers. Only final minor adjustments are to be made with register and diffuser dampers. Balancing of the air system shall be accomplished without causing objectionable air noise. Baffles and orifice plates required for proper air balance shall be furnished and installed by the contractor. Basically the following tests and adjustments are required.

- a) Test all fan systems to provide proper cfm/ cmh.
- b) Adjust fresh air, return air and exhaust dampers to provide proper air quantities in all modes of control.
- c) Test and record fresh air, return air and mixed air temperature at all air handling units. Test and record data at all coils after air and hydronic systems are balanced. Measure wet and dry bulb temperature on cooling coils.

- d) Make point tube transverse at all main supply and return ducts to set proper air quantities. Adjust all zone and branch dampers to proper cfm/cmh.
- e) Test and adjust each register, grills, diffuser or other terminals equipment to within 5% of design air quantity. Each opening shall be defined on the test report by size, manufacturer's model, room location, design cfm and actual cfm. Outlets shall be adjusted to minimize objectionable drafts.
- f) Test and record static pressure drop across all filters and major coils.
- g) High velocity duct systems shall be tested for leakage. If excessive or audible leakage is detected, the defect shall be repaired by the contractor. Sufficient static pressure readings shall be taken from the air handling units to the terminal units to establish system static pressure.

### 7.7.3 Balancing Tolerance:

Systems shall be balanced within the following tolerances ;

- i) Duct leakage Rates (at operating pressures) :
 

Low pressure ducts	5% of full flow (0 to 0.5 kPa)
Medium Pressure Ducts	1% of full flow (0.5 to 3 kPa)
High Pressure Ducts	1% of full flow (Greater than 3 kPa)
- ii) Air flow rates :
 

Under 70 L/S	10% of flow
Over/ at 70 L/S	5% of flow
- iii) Heat flow rates :
 

Heat exchangers	5% of design capacity
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#### Procedure:

Review all pertinent plans, specifications, shop drawings and other documentation to become fully familiar with the systems and their specified and intended performance.

Furnish equipment and instruct sheet metal trade on proper use for conducting duct leakage tests. Conduct first test as a way of instructing the above trades in the presence of the Department's representative.

Test relative barometric pressures in various building area, as deemed necessary by the Department's representative and at least in all areas served by different systems.

Test performance and continuously record on a 24 hour basis, temperature and humidity levels where control equipment is provided for that purpose in certain critical areas.

Before commissioning of the equipment, the entire electrical installation shall be tested in accordance with relevant BIS codes and test report shall be furnished by a qualified and authorized person.

### 7.7.4 Reports

Provide 3 copies of the complete balancing and testing reports to the department. Report shall be neatly typed and bound suitable for a permanent record. Report forms shall contain complete test data and equipment data as specified and safety measures provided to ensure safety of the operating personnel at all times.

#### **7.7.5 Final documentation**

The contractor shall leave the system operating in complete balance with air quantities as shown on drawings. Set stops on all balancing valves and lock all damper quadrants in proper position. Secure all automatic damper and valve linkages in proper positions to provide correct operating ranges. Proper damper positions shall be marked on ducts with permanent indication. Notify the department of any areas marginal or unacceptable system performance.

The above tests and procedures are mentioned herein, for general guidance and information only, but not by way of limitation to the provisions of conditions of contract and design/ performance criteria.

Upon commissioning and final handover of the installation, the HVAC contractor shall submit (within 4 weeks) to the engineer-in-charge/ department 6 (six) portfolios of the following indexed and bound together in hard cover ring binder (300 x 450 mm) in addition to the completion drawings.

- a) Comprehensive operation and maintenance manual
- b) Test certificates, consolidated control diagram and technical literature on all controls.
- c) Equipment warranties from manufacturers.
- d) Commissioning and testing reports
- e) Rating charts for all equipment
- f) Log books as per equipment manufacturers standard format
- g) List of recommended spares and consumables.
- h) Any special tools required for the operation or the maintenance of the plant shall be supplied free with the plant.

At the close of the work and before issue of final certificate of completion by the Engineer-in-charge, the contractor shall furnish a written guarantee indemnifying the department against defective materials and workmanship for the Defects liability period. The contractor shall hold himself fully responsible for reinstallation or replace free of cost to the department.

- i) Any defective material or equipment supplied by the contractor
- ii) Any material or equipment supplied by the department which is proved to be damaged or destroyed as a result of defective workmanship by the contractor.

### **8.0 MAINTENANCE DURING DEFECT LIABILITY PERIOD**

- 8.1** The scope of maintenance during defect liability period shall include carrying out all sort of Scheduled/unscheduled maintenance of complete air-conditioning system including all items related with comprehensive maintenance of the HVAC system as per OEM specified maintenance schedule/National Building Code (NBC) 2016 guidelines. Repair & replacement of defective components, providing of spares and all other associated accessories which are not covered

otherwise and attention of all types of defects, necessary for smooth operation of the HVAC system to the satisfaction of Engineer-in Charge/DFCCIL. The Contractor should also carry out any other schedule jointly decided by Engineer-in-charge/DFCCIL and the Contractor for any equipment of the HVAC system to ensure smooth and trouble-free functioning.

This includes maintenance of Complete VRF based HVAC system including accessories, consumable item like oil, compressor and Refrigerant etc. during defect liability period.

- 8.2** The Contractor shall carry out Comprehensive, Preventive & Breakdown maintenance including Daily, Weekly, Monthly, Quarterly and Yearly maintenance of the VRF HVAC system at HHRI, DFCCIL Complex at Sector 145, Noida in terms of OEM guidelines & relevant NBC 2016 standards. The maintenance schedules and the work to be done in each schedule & report format shall be jointly decided by the Engineer-in-Charge/DFCCIL & the Contractor.

**8.3 Maintenance shall inter-alia include but not limited to following:**

- a. Indoor Units (**IDUs**) of various type/size complete with electric/electronic components, wiring, power cord, remote & accessories.
- b. Regular cleaning of IDU filters and AHU filters (every 21 days) and replacement as prescribed by **OEM**. Wet cleaning of IDU's shall be done once in every 06 (Six) months and complete Dry cleaning of IDU, once in every 03 (three) month. Record of filter cleaning shall be maintained.
- c. Outdoor Units (**ODUs**) of various capacities complete with, compressors, piping, electric/electronic components, consumables, supports & any other associated work for proper & specified functioning of outdoor units.
- d. Refrigerant piping along with all joints etc. including detection/repairing of leakage, pressure testing, vacuum purging, gas recharging/ topping including supply of refrigerant.
- e. The repair work shall be carried out in a professional manner. This shall also include restoration of insulation after repair. Any other associated work for proper & specified functioning of air conditioning system. The scope also includes supply & charging of refrigerant due to any unforeseen circumstances.
- f. Condensate drain water pipe cleaning, detection/repairing of pipes for any leakages, insulation etc. Any other associated work for proper functioning of drain water disposal system.
- g. All control & power wiring between indoor & outdoor units. Any other associated work for proper & specified functioning of air conditioning system.
- h. Maintenance & upkeep of sub-AC panels on the roof including switchgear, cabling from sub-AC panel up to outdoor units, feeder pillars, consumables etc (excluding incoming cables to sub-AC panels).
- i. Maintenance of central remote control.
- j. Any other item/activities associated with proper functioning of complete HVAC system deemed to have been included in the scope of work.
- k. In order to attend breakdown of the HVAC system, minor engineering works (eg. False ceiling, any kind of structural/masonry work, opening and closing) required if any, shall also be in the scope of work.

**8.4 Deployment of CAMC Staff:**



- a. The contractor shall depute technically qualified, competent and experienced staff in adequate number for the schedule maintenance. It may however be noted that normally scheduled maintenance should be carried out on Saturday & Sunday or any Gazetted Holidays for which the contractor will give at least 24 hours notice to the Engineer-in-Charge/DFCCIL.
- b. For health check, operational assistance, quick redressal of complaints regarding HVAC system and to maintain maintenance work record, one experienced Technician with necessary tools shall remain present in DFCCIL-HHRI Building site during all working days.
- c. Additional staff shall be deputed to reduce the downtime for attending major breakdowns as desired by DFCCIL.
- d. The work is to be carried out as per OEM guidelines/best industry practices and in such a manner that the premises always look Neat & Clean.

#### 8.5 Attending to complaints:

- a. List of minimum spares to be available at site for smooth operation shall be prepared by the Contractor and Engineer-in-charge within 07 days of **commissioning of HAVC system (in part or full)** and accordingly all spares shall be available within **07 days**.
- b. After handing over of work, the Contractor shall submit list of authorised contact persons in ascending order of hierarchy (Escalation Matrix) to whom complaints can be lodged.
- c. All defects and deficiencies should be rectified promptly after lodging of complaint. The complaint can be lodged through intercom, telephonic message or through complaint register kept in Control Room. A Ticket would be raised for every complaint in which any/ all parts of the HVAC system is defective. The ticket will be closed when complaint is resolved to the satisfaction of the Engineer-in-Charge.
- d. Response Time (Max) – 30 Minutes, to reach the site of complaint.
- e. Rectification Time (Max.) - 03 Hrs. If Max. 03 IDU and ODUs/per FAHUs (except leakage, compressor, condenser failure) are involved.
- f. Rectification Time (Max.) - 12 Hrs. If 04 to 10 IDU and ODUs/per FAHUs (except leakage, compressor, condenser failure) are involved.
- g. Rectification Time (Max.) – 48 hrs. for Leakages in refrigerant circuit, defect in compressor, condenser and IDU/ODU.
- h. The quantum of work involved should be decoded within 30 minutes of the complaint received and recorded jointly with the representative of the Contractor and Engineer-in-charge/DFCCIL.
- i. Status of spares shall be jointly signed on every Friday at 17.00 hrs & timeline submitted for replenishment, if required.
- j. For expeditious disposal of complaints, the contractor shall maintain following minimum spares & consumables at site. These spares shall be replenished as soon as the designated quantity will get used:

SN	Description	Quantity
1	Refrigerant 410A	2 cylinders
2	Nitrogen Gas	01 Cylinders

3	Condenser fan motor	02
4	Condenser fan blade	02
5	PCB – ODU	02
6	PCB – IDU	02 of each type
7	IDU Motor – Ductable	01 (each type)
8	Blower Ductable	01 set each type
9	MCB 63A or as required	05
10	Contactor	02
11	Inverter/Digital compressor	02 each type
12	FAHU Motors of Different ratings	02 of each type
13	Water pump for IDU	02 each type
14	Water level sensor	02 each type
15	Capacitors ODU/IDU	05 each type
16	IDU motor (Cassette)	1% of the holding. 1 motor for each type
17	IDU display	02 each type
18	Terminal Block	02 nos
19	Thimbles	06 nos each type

- a. The spares shall be of OEM/same make. Where the 'Make' of item is not identified/ defined, it shall be of reputed make with the approval of Engineer in-charge/DFCCIL.
- b. In case the above spares (quantities) are not maintained at site by the Contractor, DFCCIL may impose penalty on the contractor for deficiency in service.

## 8.6 Maintenance of Records:

- a. The contractor shall maintain proper log sheets for recording of temperature/Relative Humidity at nominated places as decided by Engineer-in-Charge.
- b. Separate log sheets shall be maintained for Routine/Preventive/Breakdown maintenance. Format shall be approved from Engineer-in-Charge/DFCCIL.
- c. Joint recording of temperature & Humidity shall be done every Monday, preferably 15.00 hrs to check performance of the system.
- d. Joint recording of compressor currents & refrigerant temperatures shall be done on fortnightly basis to cover entire circuits in a month.
- e. A record of tripping of safety devices should be maintained. The Contractor shall provide a report to the Engineer at the end of every week indicating the defect of the system and target date of rectification/replacement.

- f. Proper record of maintenance schedule to be maintained & should be available for check anytime.

**8.7 Penalty for delay in Maintenance work:**

- a. As soon as any defect of technical nature is noticed by the Contractors staff, it shall be informed to the Engineer-in-Charge/DFCCIL in writing with details, whether it is of minor or major fault and possible time of rectification.
- b. A penalty will be imposed in case any complaint remains unattended after the rectification time is over, as under:
  - i. @ Rs. 500/- per IDU, ODU and FAHU per 03 hrs, towards clause no. 8.5 (e)
  - ii. @ Rs.2,500/- per ODU and FAHU per 12 hrs, towards clause no. 8.5 (f).
  - iii. @ Rs.5,000/- per ODU per 24 hrs, towards clause no. 8.5 (g).
- c. After report of failure, if maintenance personnel does not start work at site/ advice the action plan to attend the failure, penalty @ Rs. 500/- per hour or part thereof shall be levied to ensure that proper cooling is maintained in the entire premise & there shall be no discomfort to the occupants.
- d. After 7 days of non-rectification of a failure without any valid & justifiable reason, the cost of damage to HVAC system or DFCCIL property, if any due to failure of system will be sole responsibility of the contractor & the cost of damage of the same shall be borne by the contractor. After 7 days, DFCCIL has right to get the work done on risk & cost of contractor without further intimation.
- e. The decision regarding penalty and imposition of penalty shall be solely under the discretion of the Officer In-charge of the DFCCIL. The total amount of liquidated damages under this condition shall not exceed 5% of the contract value.

**TECHNICAL SPECIFICATION FOR  
LOW VOLTAGE WORKS  
(SECTION-7)**

## **TECHNICAL SPECIFICATION FOR CONSTRUCTION.**

### **LOW VOLTAGE WORKS**

#### **1. ADDRESSABLE FIRE DETECTION & ALARM SYSTEM**

##### **A. General Fire Alarm System Description**

1. Fire detection and Alarm System shall consist of Fire Alarm Control Panels, various types of equipment' slike Detectors, hooters, Strobes, monitor & control modules, Repeater panel, and different types of cables located at various strategic locations of the building.
2. In case of a Fire alarm initiation by an alarm initiating device, the audio-visual fire alarm shall be generated at the respective Fire Alarm Control Panels and at Repeater panel located in the Control Room, various location and also initiate signal to operate hooters located in various locations.
3. All types of addressable detectors / interface units shall be compatible with the fire alarm panel.
  - (i) All the alarm initiating devices that are asked for to be self-addressable type shall be of self-addressable type. In case of non-addressable detectors the detector status shall be monitored through a Conventional Zone Interface Module (CZIM) to send the analogue information available from the detector to FACP. The BIDDER shall clearly indicate what are all the device /detectors which are not self-addressable in type and shall include CZIM module to make that device / detector addressable. The CZIM module cost shall also be considered as included in the detector cost.
  - (ii) The detector shall be suitable to connect to the control unit via a four-wire circuit (Class –A wiring) as per NFPA.
  - (iii) The Fire Alarm System envisaged for this Building is “2-Wire Analog Addressable ”type.
  - (iv) The communication between detectors and the FACP is by means of digital communication over 2-wire, which further provides power to the detectors, devices & Sounders. There shall be A/D and D/A conversion happening inside the detectors and FACP.
  - (v) All the detectors shall be incorporated with microprocessors and shall be provided with Analog to Digital Converter (ADC), which enables the detector to provide linear output corresponding to the quantity of smoke or fire, the detector encounter.
  - (vi) All types of detectors offered will be of restorable type i.e. suitable for operating afresh after each actuation on alarm without replacement or adjustment.
  - (vii) The sensitivity of each sensor shall be individually adjusted from the FACP to suit the conditions of each location. Each detector shall have self-test facility, which is monitored in the FACP. Each detector shall have drift compensation.
  - (viii) The response sensitivity shall also be field adjustable and not only from fire panel over a wide range to suits it conditions. It shall be possible to test the sensitivity of a detector in the field. The

sensitivity / threshold value of detectors which are cross zoned must be compatible.

- (ix) The FACP shall also check each sensor for contamination of dust/dirt and give signal for “Service” in case of accumulation of dust/dirt reaches a preset limit.
- (x) The fire alarm system shall work without any problem both in networked mode and in standalone mode.
- (xi) The electronic circuit shall be of solid state and of failsafe design and virtually hermetically sealed to have resistance to humidity and corrosion and to prevent its operation from being impaired by dust and dirt.
- (xii) The circuit shall be protected against usual electrical transients, electromagnetic and electrostatic interference (EMI & RFI) present in the Building.
- (xiii) Reverse polarity or fault in the field wiring shall not damage the detector.
- (xiv) No moving parts subject to wear & tear shall be provided.
- (xv) All types of detectors & devices offered shall have a inbuilt fault isolator. The fire detectors shall be plug in type. Suitable locking device shall be supplied along with each detector. It shall be inserted into or removed from the standard base by simple push twist mechanism to facilitate easy exchange / cleaning and maintenance.
- (xvi) The system shall have following self-diagnostic features:
  - (a) Detector cabling shall be completely supervised for open circuit and short circuit and exact location of fault shall be displayed in the panel under Trouble/Faults.
  - (b) Un-authorized removal of a detector head from its base shall be supervised to give an alarm on the connected control panel.
  - (c) Annunciation shall be provided for DC fuse blown and loss of main AC supply etc.
  - (d) Alarm verification features.

## **B. Analogue Addressable Fire Alarm Control Panel (FACP)**

The FACPs used in the Building shall confine to the EN54 standards having the following features.

### **Features:**

- 1) All the FACPs provided shall have the capacity to expand from 1 to 32 loops for Future expansion.
- 2) Each loop shall accommodate maximum 254 detectors and devices with a loop length capable up to 1.6 kms with 2C x 1.5 sq mm cable.

- 3) It shall have facility to discriminate between a real fire alarm and a false alarm.
- 4) FACP will function as fully stand-alone panel & also networked to other FACP's with peer to peer communication.
- 5) Each FACP shall have a possibility of accommodating redundant controller to takeover in case of a Failure in the Primary Controller and also redundant loop card for each loop to takeover in case of a Failure in the Primary Loop Card.
- 6) It shall have a provision for battery storage.
- 7) In case of a Loop Card Failure, the FACP shall allow to replace the Loop card without switching off the panel and reprogramming.
- 8) The FACP shall have facility such that alteration or access to the stored program shall be done through a pass-code, for protection against unauthorized personnel interference.
- 9) The FACP shall be capable of PA Integration with the use of RS232 module or with the use of relays.
- 10) FACP shall have provision to accept 230V single phase, 50 Hz supply.
- 11) All the major components like processor, memory, etc., shall be available as spare in case of emergency requirement.
- 12) FACP's shall have inbuilt buzzer to alert the personnel in case of maintenance requirement.
- 13) FACP shall be programmed for sequence of events to happen in case of fire like closing of fire dampers, shutting down supply fans for HVAC, Deactivating the access control system and activating the hooters with the help of a control relay module provided near the system to be activated.
- 14) The fire alarm control panel shall be suitable for Class-A type of wiring as per NFPA-72.
- 15) The fire alarm control panel shall work on positive sequence as per NFPA –72.
- 16) The fire alarm control panel shall be capable of disabling an individual detector, a group and or zone of for building maintenance purposes. Facility shall be provided on the FACP for simulating the fire condition to enable testing of the various alarm circuits.
- 17) The fire alarm control panel normal power supply failure shall be annunciated audio-visually.
- 18) In case of multiple alarms, the multiple alarm indication shall be ON. The multiple alarm indication shall be displayed in chronological order.
- 19) FACP shall have the facility such that each detector can be identified as a separate zone.

- 20) The FACP shall be reset only by authorized users after the clearance of a fault.
- 21) Whenever there is a third party actuation to happen, like closing of fire dampers, switching off supply /exhaust units etc, the actuation shall happen only when the fire signal is received from two different initiating devices located in a zone connected to different fire alarm panels. The communication between the FACP's shall happen with two pair cables and the fire alarm status of one panel shall be communicated to the second panel in which the control relay module of the third-party device is connected to. Inter panel communication is a must and needs to be provided for controlled actuations. All the necessary systems to ensure reliable communications between panels are to be built into the FACP's.
- 22) FACP shall have the facility to silence / acknowledge / reset the alarm. Apart from the FACP, Repeater panel present in the control room shall have the facility to silence / acknowledge / reset the alarm of all FACP's.
- 23) The FACP shall have FALSE ALARM REDUCTION algorithms like
- Alarm Verification, Dual Detector/Group Dependency, and Intermediate Alarm Storage to eliminate False alarms due to Dirt/Dust/Disturbance values.
- 24) When fire condition is confirmed, the following sequence of annunciation will take place on the FACP:

Alarm Condition	Audible Alarm	Visual Alarm
First Fire Condition	ON	ON FLASHING/Description of area of fire origin with detector type
Acknowledge (first Alarm)	OFF	ON STEADY
New Fire Alarm Condition (after acknowledging of first alarm)	ON	ON FLASHING
Acknowledge (New fire alarm)	OFF	ON STEADY
Back to normal	OFF	ON STEADY
Reset	OFF	OFF
Reset Before Normal	OFF	ON STEADY

#### A. Construction details

- 1) The housing containing the fire alarm control panel shall be of 2 mm thick steel construction finished in colour as per relevant standard.



- 2) It shall be capable of being surface, semi-flush or fully flush mounted with additional bezel. The fully flush bezels shall be painted to specification, stainless steel or brass as required.
- 3) The FACP's shall be provided with triplicated earthing terminals on the either side. The grounding terminal G1 shall be for safety grounding, G2 shall be for shield grounding and G3 shall be for signal grounding.
- 4) The panel shall be completely factory wired, absolutely ready-in all respects for installation at site and termination of all external cabling. The internal wiring of the panel shall be carried out with 650 V grades, stranded copper wires of size rated for the current in the corresponding circuit. The minimum size of the wire shall not be less than 0.8 sq. mm for electronic circuits and 1.5 sq. mm for electrical circuits & 16 SWG for grounding.
- 5) All the wiring shall be done using ferrules having indelible marking.
- 6) Cable entry for the FACP from the bottom
- 7) FACP shall mount in wall.

**B. CPU**

- 1) The FACP shall have a processor which shall be of at-least 32 bit, which shall be designed to accept all the inputs and process the outputs within the time stipulated by the standards.
- 2) A redundant CPU shall be provided with the same configuration which shall be made as hot standby – in case of failure of the main CPU, the standby shall takeover without interrupting the system.
- 3) The CPU shall have the facility to communicate with other FACP's and process the fire signals received from other FACP's to actuate a third party device.
- 4) The capacity of the processor shall be adequately designed include all input / output signals and various functional requirements.
- 5) The process or shall be designed in such a way that the parameters in there peater panels shall be refreshed in 1sec.
- 6) It shall have its own, built in advanced microprocessor, sophisticated software and extensive memory for storing the logs of alarms, times and action taken report.

**C. Loop Modules**

The loop module shall have a microprocessor inbuilt & shall be capable of handling 254 detectors/devices.

It shall have a line length up to 1600m or 3000m depending upon the configuration & cable type.

It shall have an LED test button.

The front fascia of the loop cards shall be visible for easy identification of faults.

In case of the failure of loop card, it should be replaced without the need of any additional programming.

#### **D. Repeater Panels**

- 1) It shall be a LCD displays same as main panel. The MMI shall be the same as the main Controller.
- 2) Repeater panels shall be suitable for Wall mounting which will be displayed all the major entrances and stair cases which will enable the staff and fire fighting personnel to exactly locate the fire.
- 3) It shall be compatible to receive data from FACP's.
- 4) Audio visual Alarms during fire shall be generated in case of fire.
- 5) It shall connect to any of the Fire Panels in the Network using a 2 core – 1.5 sq.mm wire.
- 6) The Repeater Panel shall display Messages like Alarm & Fault similar to the Main Panel and shall be accessed only by Authorized Users through a passcode.
- 7) The Repeater Panel shall be connected to the Main Panel and other repeater panels in such a way – 1 pt Failure in the cable shall not affect the performance and shall intimate the exact location of failure in all Panels.
- 8) The Repeater Panel shall be equipped with a Key switch that allows Authorized users to Acknowledge / Reset Alarms.
- 9) The Repeater Panel shall be equipped with 2 different power inputs. On failure of primary power, the secondary shall takeover.
- 10) The Repeater panel shall allow the users to login locally or login to the remote FACP.
- 11) The Repeater panel shall allow to create users with different access levels locally and shall also allow users of panels to login based on access levels.
- 12) The repeater panels shall integrate with the main panels without any additional interface or the bidder shall consider necessary accessories required to complete the system and quote as part of this model.

#### **E. Intelligent Addressable Dual Optical Smoke/Heat (Multisensory) Detector**

The Intelligent Addressable Multisensor Detector with 2 LED's used in this Building shall conform to the relevant standards having the following features

- 1) It shall be combination of Smoke detection and heat detection. The smoke detection system shall work on Light scattering type principle using Infrared & Blue Led's, and the Heat detection system shall be of Rate of rise of temperature and Fixed Temperature.
- 2) The Intelligent Addressable Multisensor Detector shall be of Spot type and Addressable type.
- 3) The Intelligent Addressable Multisensor Detector shall be addressed either by DIP switches or through Programming from the Panel.
- 4) The Detector shall monitor EMC/EMI values in the surroundings on a continuous basis and report the current & average values to the panel. The detector and the panel shall together avoid the possibility of false alarm caused due to interferences from sources such as Motors, power cables, Wi-Fi routers, fluorescent lamps, network switches, mobile signals etc.
- 5) All the detectors shall have a visible multi-color LED to indicate the healthiness / trouble /

alarm condition of the detector. The LED shall be located in such a way that it shall be visible from all the 360 degree from below. In some cases where the visibility of the detector is obstructed by cable trays, false ceiling etc. Facility for connecting the detector to a response indicator has to be present. The response indicator derives the power to glow from the loop.

- 6) It shall possess False alarm immunity and a superior signal to noise ratio
- 7) It shall have a Built-in signal processor
- 8) It shall have drift compensation facility built in.
- 9) The detectors shall communicate the ambient trending to the FACP on time to time basis, and the FACP shall make the decision about the current status of the detector, whether it is in fire/pre-alarm/maintenance requirement etc.
- 10) The detector shall have atleast 15 levels of sensitivity settings based on the application and room where it is installed.
- 11) The detector shall provide a chamber maid plug to blow out the dust/dirt using a blower.
- 12) In case of a failure, panel shall allow to replace the detector with the same type without the need of additional programming
- 13) The detector shall be programmed to work as Optical only or Thermal only detectors. It shall a provision to switch off any component (optical or thermal) of the detector.
- 14) The detector shall work with 2 different sensitivity settings at any point of time and the User shall have access to choose the desired settings without programming or Laptop/PC for configuration.
- 15) The detector shall change sensitivity settings based on day/night mode or with schedules based on the programming.
- 16) The detector shall have Intermediate Alarm Storage, Dual Detector Dependency, Dual group Dependency features that shall be programmed based on site application.
- 17) The detector shall be capable of detecting both smoldering fires and open fires and shall be EN54 /VdS/ULapproved.

#### **F. Intelligent Addressable Optical Smoke/ Heat (Multisensor) Detector**

The Intelligent Addressable Multisensor Detector used in this Building shall confine to the relevant standards having the following features

- 1) It shall be combination of Smoke detection and heat detection. The smoke detection system shall work on Lights cattering type principle using Infra red and the Heat detection system shall be of Rate of rise of temperature and Fixed Temperature.
- 2) The Intelligent Addressable Multisensor Detector shall be of Spot type and Addressable type.
- 3) The Intelligent Addressable Multisensor Detector shall be addressed either by DIP switches or through Programming from the Panel.
- 4) The Detector shall monitor EMC/EMI values in the surroundings on a continuous basis and report the current & average values to the panel. The detector and the panel shall together avoid the possibility of false alarm caused due to interferences from sources such as Motors, power cables, Wi-Fi routers, fluorescent lamps, network switches, mobile signals etc.
- 5) All the detectors shall have a visible multi-color LED to indicate the healthiness /trouble / alarm condition of the detector. The LED shall be located in such away that it shall be visible from all the 360 degree from below. In some cases where the visibility of the detector is obstructed by cable trays, false ceiling etc. Facility for connecting the detector to a response

- indicator has to be present. The response indicator derives the power to glow from the loop.
- 6) It shall possess False alarm immunity and a superior signal to noiseratio
  - 7) It shall have a Built in signal processor
  - 8) It shall have drift compensation facility built in.
  - 9) The detectors shall communicate the ambient reading to the FACP on time to time basis, and the FACP shall make the decision about the current status of the detector, whether it is in fire/pre-alarm/maintenance requirement etc.
  - 10) The detector shall have at least 15 levels of sensitivity settings based on the application and room where it is installed.
  - 11) The detector shall provide a chamber maid plug to blow out the dust/dirt using ablower.
  - 12) In case of a failure, panel shall allow to replace the detector with the same type without the need of additional programming
  - 13) The detector shall be programmed to work as Optical only or Thermal only detectors. It shall have a provision to switch off any component (optical or thermal) of the detector.
  - 14) The detector shall work with 2 different sensitivity settings at any point of time and the User shall have access to choose the desired settings without programming or Laptop/PC for configuration.
  - 15) The detector shall change sensitivity settings based on day/night mode or with schedules based on the programming.
  - 16) The detector shall have Intermediate Alarm Storage, Dual Detector Dependency, Dual group Dependency features that shall be programmed based on site application.
  - 17) The detector shall be capable of detecting both smoldering fires and open fires and shall be EN54 /VdS/UL approved.

#### **G. Intelligent Addressable Dual Optical Smoke Detector with 2 LED's-Infrared &Blue**

The Intelligent Addressable Photo electric smoke Detector with 2 LED's-Infrared & Blue used in this Building shall conform to the relevant standards having the following features:

- 1) The smoke detection system shall work on Light scattering type principle using Infrared & Blue LED's.
- 2) The Intelligent Addressable smoke Detector shall be of Spot type and Addressable type.
- 3) The Intelligent Addressable Smoke Detector shall be addressed either by DIP switches or through Programming from the Panel.
- 4) The Detector shall monitor EMC/EMI values in the surroundings on a continuous basis and report the current & average values to the panel. The detector and the panel shall together avoid the possibility of false alarm caused due to interferences from sources such as Motors, power cables, Wi-Fi routers, fluorescent lamps, network switches, mobile signals...etc.
- 5) All the detectors shall have a visible multicolor LED to indicate the healthiness /trouble / alarm condition of the detector. The LED shall be located in such away that it shall be visible from all the 360 degree from below. In some cases where the visibility of the detector is obstructed by cable trays, false ceiling etc. Facility for connecting the detector to a response indicator has to be present. The response indicator derives the power to glow from the loop.
- 6) It shall possess False alarm immunity and a superior signal to noiseratio
- 7) It shall have a Built in signal processor
- 8) It shall have drift compensation facility built in.
- 9) The detectors shall communicate the ambient reading to the FACP on time to time basis, and

the FACP shall make the decision about the current status of the detector, whether it is in fire/pre-alarm/maintenance requirement etc.

- 10) The detector shall have at least 3 levels of sensitivity settings based on the application and room where it is installed.
- 11) The detector shall provide a chamber maid plug to blow out the dust/dirt using ablower.
  - (a) In case of a failure, panel shall allow to replace the detector with the same type without the need of additional programming
  - (b) The detector shall work with 2 different sensitivity settings at any point of time and the User shall have access to choose the desired settings without programming or Laptop/PC for configuration.
  - (c) The detector shall change sensitivity settings based on day/night mode or with schedules based on the programming.
  - (d) The detector shall have Intermediate Alarm Storage, Dual Detector Dependency, Dual group Dependency features that shall be programmed based on site application.
  - (e) The detector shall be capable of detecting both smoldering fires and open fires and shall be EN54 /VdS/UL approved.

#### **H. Intelligent Addressable Optical Smoke Detector**

The Intelligent Addressable Photo electric smoke Detector with Infrared LED used in this Building shall confine to the relevant standards having the following features

- (a) The smoke detection system shall work on Light scattering type principle using Infrared Led's.
- (b) The Intelligent Addressable smoke Detector shall be of Spot type and Addressable type.
- (c) The Intelligent Addressable Smoke Detector shall be addressed either by DIP switches or through Programming from the Panel.
- (d) The Detector shall monitor EMC/EMI values in the surroundings on a continuous basis and report the current & average values to the panel. The detector and the panel shall together avoid the possibility of false alarm caused due to interferences from sources such as Motors, power cables, Wi-Fi routers, fluorescent lamps, network switches, mobile signals...etc.
- (e) All the detectors shall have a visible multicolor LED to indicate the healthiness /trouble / alarm condition of the detector. The LED shall be located in such away that it shall be visible from all the 360 degree from below. In some cases where the visibility of the detector is obstructed by cable trays, false ceiling etc. Facility for connecting the detector to a response indicator has to be present. The response indicator derives the power to glow from the loop.
- (f) It shall possess False alarm immunity and a superior signal to noiseratio
- (g) It shall have a Built in signalprocessor
- (h) It shall have drift compensation facility builtin.
- (i) The detectors shall communicate the ambient reading to the FACP on time to time basis, and the FACP shall make the decision about the current status of the detector, whether it is in fire/pre-alarm/maintenance requirement etc.
- (j) The detector shall have at least 3 levels of sensitivity settings based on the application and room where it is installed.
- (k) The detector shall provide a chamber maid plug to blow out the dust/dirt using a blower.
- (l) In case of a failure, panel shall allow to replace the detector with the same type without the need of additional programming
- (m) The detector shall work with 2 different sensitivity settings at any point of time and the User shall

- have access to choose the desired settings without programming or Laptop/PC for configuration.
- (n) The detector shall change sensitivity settings based on day/night mode or with schedules based on the programming.
- (o) The detector shall have Intermediate Alarm Storage, Dual Detector Dependency, Dual group Dependency features that shall be programmed based on site application.
- (p) The detector shall be capable of detecting both smoldering fires and open fires and shall be EN54 /VdS/ULapproved.

## **I. Intelligent Addressable Heat Detector**

The Intelligent Addressable Heat Detector used in this Building shall confine to the relevant standards having the following features

1. The Heat detection system shall be of Rate of rise of temperature and Fixed Temperature.
2. The Heat Detector shall be of Spot type and Addressable type.
3. The Heat Detector shall be addressed either by DIP switches or through Programming from the Panel.
4. The Detector shall monitor EMC/EMI values in the surroundings on a continuous basis and report the current & average values to the panel. The detector and the panel shall together avoid the possibility of false alarm caused due to interferences from sources such as Motors, power cables, Wi-Fi routers, fluorescent lamps, network switches, mobile signals...etc.
5. All the detectors shall have a visible multicolor LED to indicate the healthiness /trouble / alarm condition of the detector. The LED shall be located in such away that it shall be visible from all the 360 degree from below. In some cases where the visibility of the detector is obstructedby cable trays, false ceiling etc. Facility for connecting the detector to a response indicator has to be present. The response indicator derives the power to glow from the loop.
6. It shall possess False alarm immunity and a superior signal to noise ratio
7. It shall have a Built in signal processor
8. It shall have drift compensation facility built in.
9. The detectors shall communicate the ambient reading to the FACP on time to time basis, and the FACP shall make the decision about the current status of the detector, whether it is in fire/pre-alarm/maintenance requirement etc.
10. In case of a failure, panel shall allow to replace the detector with the same type without the need of additional programming
11. The detector shall work with 2 different sensitivity settings at any point of time and the User shall have access to choose the desired settings without programming or Laptop/PC for configuration.
12. The detector shall change sensitivity settings based on day/night mode or with schedules based on the programming.
13. The detector shall have Intermediate Alarm Storage, Dual Detector Dependency, Dual group Dependency features that shall be programmed based on site application.

The detector shall be capable of detecting both smoldering fires and open fires and shall be EN54 /VdS/ULapproved.

**J. Addressable Ventilation Duct Smoke Detectors**

The detector shall have housing for accommodating a special detector that detects smoke in ventilation ducts, with input and output for air sample extraction, streamlined connection pipes for optimum air flushing of the detector, with dust-proof connection board for the loop outside the air flow, with air intake and exhaust pipe, seals and the required installation material

- (a) The Duct smoke Detector used in this Building shall confine to the relevant standards having the following features
- (b) The smoke detection system shall work on Light scattering type principle using Infrared. The detector shall better false alarm immunity and shall have a processor inbuilt with ISP.
- (c) Duct Detector shall be Addressable type.
- (d) The Dual Detector shall be loop powered and addressed either by DIP switches or through Programming from the Panel.
- (e) All the detectors shall have a visible multicolour LED to indicate the healthiness /trouble / alarm condition of the detector. The LED shall be located in such away that it shall be visible from all the 360 degree from below. In some cases where the visibility of the detector is obstructed by cable trays, false ceiling etc. Facility for connecting the detector to a response indicator has to be present. The response indicator derives the power to glow from the loop.
- (f) It shall possess False alarm immunity and a superior signal to noise ratio
- (g) It shall have a Built in signal processor
- (h) It shall be with inbuilt fault isolators.(Detectors without Inbuilt Isolators may be considered with separate Isolator Base)
- (i) It shall have drift compensation facility built in.
- (j) The detectors shall communicate the ambient reading to the FACP on time to time basis, and the FACP shall make the decision about the current status of the detector, whether it is in fire/pre-alarm/maintenance requirement etc.
- (k) The detector shall have at least 3 levels of sensitivity settings.
- (l) The detector shall provide a chamber maid plug to blow out the dust/dirt using a blower.
- (m) In case of a failure, panel shall allow to replace the detector with the same type without the need of additional programming
- (n) The detector shall work with 2 different sensitivity settings at any point of time and the User shall have access to choose the desired settings without programming or Laptop/PC for configuration.
- (o) The detector shall change sensitivity settings based on day/night mode or with schedules based on the programming.
- (p) The detector shall have Intermediate Alarm Storage, Dual Detector Dependency, Dual group Dependency features that shall be programmed based on site application.
- (q) The detector shall have Air intake and exhaust pipe , extendable up to 3m
- (r) The detector shall have necessary filters in the air intake and exit pipes.
- (s) The detector considered shall be a special detector designed for Duct applications and not a Spot type Optical detector.
- (t) The detector shall be EN54 /VdS/UL approved.

**K. Manual Call Points**

The Manual call points (MCP) used in the building shall confine to the relevant standards having the following features

- 1) Manual call points shall be of Double action - break glass type with Push Button.
- 2) The mounted arrangement shall be such that it can be either surface mounted or flush mounted.
- 3) Each addressable MCP will comprise of an electronic circuit built into it to provide addressing capability.
- 4) The MCPs shall be provided with inbuilt fault isolator. (the bidder shall consider a external isolator if not in built)
- 5) The MCP shall have a LED to indicate Alarms
- 6) The MCP shall be EN54/VdS/UL approved

**L. Control relay module (CRM)**

The Control Relay Modules used in this Building shall confine to the relevant standards having the following features

- 1) The CRM shall provide a dry potential contact o/p for activating a variety of auxiliary devices and other fire fighting / ventilation equipment.
- 2) The CRM shall have inbuilt fault isolator module. ( bidder shall consider external isolators if not in built)
- 3) It shall have a capability of handling at least 1A @ 30VDC to integrate with third party system.
- 4) The CRM shall be addressable either by Dip switch or by the Panel.
- 5) The CRM shall be EN54/VdS/UL approved.

**M. Monitor Module (Input module) (MM)**

The Monitor Modules used in this Building shall confine to the relevant standards having the following features.

- 1) The MM shall provide 2 inputs and these inputs shall work independently to monitor 3rd party devices and shall allow to program with different parameters.
- 2) The MM shall have inbuilt fault isolator module.(bidder shall consider external isolators if not in built)
- 3) The MM shall be programmed to monitor contacts, Voltage and EOL resistor as per site applications.
- 4) The MM when programmed to monitor contacts shall also allow to program to monitor either open/close contacts.
- 5) The MM shall be addressable either by Dip switch or by the Panel.
- 6) The MM shall be EN54/VdS/UL approved.

**N. Addressable interface (Conventional Zone Interface module -CZIM)**

The CZIM Modules used in this building shall confine to the relevant standards having the following features.

- 1) Addressable interface units will be provided for all non-addressable detectors/devices such as **beam detectors or to integrate existing conventional detectors, etc.** to assign an address to such detectors and to be compatible with addressable FACP.
- 2) Each conventional detector will have its own addressable unit in the form of CZIM Modules



for individual address. The addressable unit will facilitate connection of non-addressable detectors in the same circuit/loop consisting of addressable detectors.

- 3) It shall supervise the circuit of open dry contact I/P device & signal alarms during change of state of detectors.
- 4) The interface device shall have an LED, which flashes during polling of the FACP.
- 5) It shall have inbuilt fault isolator module or the bidder shall consider additional isolator modules.
- 6) The CZIM shall be capable of powering the Detectors through the Aux Source and shall supervise the cable, aux power and the external power supply. The CZIM shall communicate Faults and Troubles related to Detector, Power supply to the Panel.
- 7) The CZIM shall allow to reset conventional detectors from the panel.
- 8) The CZIM shall offer 2 separate zones, 2 Aux power circuits and shall monitor the external power supply and supervise the zone cables.
- 9) The CZIM shall allow Intermediate Alarm Storage, Dual detector & Dual group dependency based on site applications.
- 10) The CZIM shall allow configuring the conventional zones with Different EOL and Alarm resistor based on the existing detector type.
- 11) The CZIM shall either be din rail mount or Surface mount.
- 12) The CZIM shall have the intelligence to detect faults like 4 wireshort...etc.
- 13) The CZIM shall be EN54 /VdS approved

#### **O. Beam (Optical Beam) Smoke detector**

The Beam detectors used shall confine to the relevant standards having the following features

- 1) The beam detectors shall having a separate Transmitter (Tx) & receiver(Rx)
- 2) Beam detectors shall be externally powered via Conventional Zone Interface module (CZIM). The module shall supervise the External Power Supply, Aux Power to the Transmitter and Receiver.
- 3) It will communicate to FACP through addressable CZIM so that each detector will have individual address. The CZIM shall have inbuilt fault isolators.
- 4) The beam detector shall be suitable to protect the distance from 10 meters to 100 meters range.
- 5) The beam detectors shall communicate the ambient reading to the FACP on time to time basis, and the FACP shall make the decision about the current status of the detector, whether it is in fire/pre-alarm/maintenance requirement etc.
- 6) It shall have provision for Wall / ceiling mounting.
- 7) Beam detector shall have Response time less than 20 sec.
- 8) The response threshold values, tests shall be as per NFPA72.
- 9) It shall have feature such that in case of accidental change of alignment, it shall report an error, it shall raise a maintenance request to the FACP.

#### **P. Sounder**

The Sounder used in this Building shall confine to the relevant standards having the following features

- 1) The Sounder shall have audible sound of (Bidder shall consider external power supply, cable,

conduits, modules required for activating externally powered sounders and include the costing as part of the item –Sounders)

- 2) The Sounder shall either be addressed by Dip switch or by the Panel.
- 3) The Sounder shall be placed in the detection loop only and a separate loop or cables for sounders shall not be used
- 4) The sounder shall have a sound pressure level of 90dB and the volume shall be adjusted from the Fire Alarm Panel
- 5) The sounder shall be capable of programming at least 32 different tones for alarm detection in different floors or at different time intervals.
- 6) The sounder shall be tested and maintained with ease from the FACP
- 7) The Volume levels for Testing and Drill shall be programmed as per site conditions.
- 8) The Sounder shall consume a minimal current of <5mA and thus allowing to connect at least 25 loop powered sounders in the same loop.
- 9) The Sounder shall be capable of either accommodating a Flasher or a Detector and shall work as Sounder cum strobe or Sounder cum detector base.
- 10) The Sounder shall have a feature of synchronizing with other sounders in the loop.
- 11) The Sounder shall be loop powered and shall be EN54/VdS approved.

**Q. Strobe**

The Strobe used in this Building shall confine to the relevant standards having the following features:

- 1) The Bidder shall consider external power supply, cable, conduits, modules required for activating externally powered Strobes and include the costing as part of the item –Strobes)
- 2) The Strobe shall either be addressed by Dip switch or by the Panel.
- 3) The Strobe shall be placed in the detection loop only and a separate loop or cables for Strobe shall not be used
- 4) The Strobe shall have a red flash light and shall flash at minimum of 1Hz
- 5) The Strobe shall be tested and maintained with ease from the FACP
- 6) The Strobe shall also be part of Testing and Drill and shall be programmed as per site conditions.
- 7) The light output shall be at least 2cd
- 8) The Strobe shall consume a minimal current of 10mA and thus allowing to connect at least 10 loop powered strobes in the same loop.
- 9) The Strobe shall be capable of either fixing it in a Sounder and shall work as Sounder cum strobe as per site conditions.
- 10) The Strobe shall be loop powered and shall be EN54/VdS approved.

**R. Remote Indicator**

The Remote indicator used in this Building shall confine to the relevant standards having the following features.

The remote indicator is used when the automatic detector is installed in a place hidden or not visible like in closed rooms, false ceilings or walls.

**PA system:**

The system shall provide new and unique features for the market. Each component in the system shall be designed to suit the system needs as required.

The system shall have the following features:

- Easy configuration, but without losing the ability to solve complex requests. A configuration wizard and an expert program interface shall be provided. Fast and correct installation shall be possible, but it shall also be possible to handle complex and specific application requirements. A free programmable Task Engine shall be available via the expert mode program interface. The configuration wizard shall be able to provide a step-by-step configuration guide that creates a complete IRIS-Net system configuration file.
- Due to its flexibility, the system shall eliminate the project risk right from the start. The matrix structure shall be evident throughout the system. Dynamic routing and intelligent audio power distribution shall make the system suitable for almost any application. The system shall be designed to ensure system-wide intelligent power management architecture. The system shall raise the bar and creates a PA/EVAC system that uses the lowest power consumption for the application. It shall save batteries and maintenance costs.
- The system shall add pro-sound audio quality level to the PA/EVAC system. This high-quality level shall enable combined use of Fire/EVAC with applications that requires high-quality audio, such as presentation rooms, school stages, etc. The excellent sound quality shall ensure excellent intelligibility in all kind of situations.
- The new call station shall be designed as a modern device. The new call station shall provide a green LED on the Microphone to show that a call is going across from the call station. The system shall be able to handle up to 16 call stations.
- The system shall be capable to address up to 492 zones with a total speaker load up to 50.000 Watt.
- It shall be able to handle 4 system program sources and 12 local program inputs.
- It shall be possible to have one or more spare amplifiers in the system to take over from a duty amplifier in case one fails.
- Brackets shall be mounted on racks

## **System Controller**

The system controller shall be an EN54-16 compliant and certified device in a 2 RU, 19"-cabinet. The TCP/IP capable network device shall contain all controlling and monitoring functions of a voice evacuation system.

The controller shall manage the supervision of its own operation and that of the connected devices. It shall control and activate the connected amplifiers and spare amplifier and shall replace the amplifier routing and channel that has reported a fault.

The controller shall support single line switching or redundant group A/B switching.

Network connectivity status and fault conditions shall be displayed via LEDs on the front panel.

At least 8000 fault, warning and event conditions shall be logged internally and it shall be reported with the possibility to look real-time into the logging and save the log with logging tools. Four 100V audio inputs shall be routed to 12 speaker line outputs. Each cluster of 6 loudspeaker zones shall allow separate two-channel operation to ensure continuous business music or it shall allow to be configured to double the amount of power in a 6 zone 1 channel cluster. It also shall have an option to have multiple calls in parallel in a 2 channel operation mode.

It shall be possible to share the amplifier power with multiple routers

The controller shall provide an internal 14x 4 Audio matrix with full DSP functionality on each of the 8 inputs and 4 outputs. The controller shall operate as a four channel output matrix.

A single system controller shall be able to manage up to 20 routers, 16 call stations and up to 492 loudspeaker circuits.

It shall allow up to 4 controllable program inputs.

A built in message manager shall be able to store up to 100 emergency- or business-calls, with a total storage time up to 85 minutes.

It shall be possible to send two different messages simultaneously to individual destinations. In combination, license free spoken word evacuation sound files shall be provided in 7 languages.

A separate included tool shall provide on the fly replacing non-evacuation messages at any time without system interruption or system restart - so called hot swappable messages.

Loudspeaker supervision shall be fully controlled by the controller and executed from the router. The user shall be able to choose between no supervision, impedance measurement, simple EOL boards with pilot tone supervision (requires return wires) or via advanced addressable EOL supervision boards, which requires a ground connection but no additional return wires.

Zones outputs shall be able to handle a load from 2-500 Watt. Max. 1000 Watt per 6 zones shall be provided.

The controller shall be able to handle up to 2000 Watt load. It shall be possible to connect to a FPA5000 via Ethernet.

## **System Router**

The system router shall be an EN54-16 certified device in a 2 RU, 19" cabinet. The device shall extend the number of zones in a system and shall contain all the necessary controlling and monitoring functions.

The internal supervision system shall monitor the functions and operation of both itself and the connected devices. It shall be capable of re-routing a spare amplifier channel and shall replace an amplifier channel that has reported a fault.

Fault conditions shall also be reported to the connected system controller for operational control and logging purposes. The router shall support single line assignment or redundant group A/B switching.

Connectivity status and fault conditions shall be displayed via LEDs on the front panel, including a zone status LED.

It shall be possible to route at least 4 channels into eight 100V audio inputs to 24 loudspeaker line outputs. The router loudspeaker outputs shall be divided in clusters of 6 loudspeaker line outputs. Each cluster of 6 zones shall allow the same or a different two-channel operation mode to ensure continuous and/or different business music into different zones.

It shall be possible for each router cluster to operate as a 2-in-6 matrix (4 channel input matrix to 2-in 6 cluster).

Zone outputs shall be able to handle a load from 2-500 Watt. Max. 1000 Watt per 6 zones shall be provided.

The Router shall be able to handle up to a 4000 Watt load.

Integrated loudspeaker supervision shall eliminate the need of amplifier power for supervision, which shall result in very low power consumption.

### Technical Specifications

<b>Zone Router</b>	<b>Router including routing and supervision</b>
Audio inputs (100 V)	AMP IN: 4 × 6-pin port
– Max. voltage	120 V <sub>eff</sub>
– Max. current	7.2 A
– Max. power	500 W
Audio outputs (100 V)	SPEAKER OUT: 4 × 12-pin port
– Max. voltage	120 V <sub>eff</sub>
– Max. current	7.2 A
– Max. power	500 W
CONTROL IN	4 × 10-pin port
– Control inputs	– 10 supervised inputs (0–24V, U <sub>max</sub> = 32 V)
CONTROL OUT	4 × 10-pin port
– Control outputs	24 Low Power outputs (open collector, U <sub>max</sub> =
– Control relay	2 (NO/NC relay contacts, U <sub>max</sub> = 32 V, I <sub>max</sub> =
Interfaces	

– CAN BUS port	2 × RJ-45, 10 to 500 kbit/s (for controller, router, amplifier)
DC power input	21–32 V DC
Power consumption	5–60W
Maximum supply current	– Standby < 250mA
Operating temperature	-5 °C to 45 °C
Electromagnetic environment	E1, E2, E3

**Standards:**

The device meets the following standards (as of February 2015):

- IEC60065
- EN61000-6-3
- EN50130-4
- EN60945
- EN50581

**System Amplifier**

The 2x 500W Class D, high efficiency amplifier shall be an EN54-16 compliant and certified system device in a 2 RU, 19”cabinet. It shall provide 70/100V loudspeaker output voltages that are galvanically separated. The amplifier shall be permanently monitored by the system controller.

A special stand by mode shall be provided for saving energy during the time the amplifier is not in use with respect to all economical and super vision aspects.

**System control and audio interconnections shall be done via RJ45 connectors.**

The amplifier shall be used as a system amplifier, but it shall also be possible to use the amplifier standalone.

As a system amplifier, four automatic selectable audio inputs via RJ45 shall be available. It shall also be possible to use a local input without losing system and line supervision.

**It shall be a requirement that local input is used in case of standalone mode.**

The local input shall be configur able in away that it can be used as source input for in an installed system, for example for an external PA or local source in put. The amplifier shall have the following specifications:

- Max amplifier load: 2x 500Watt
- Class D amplifier
- 4 channel input on RJ45 connector, amp link in and out (4 channel dynamic input channel switching for each amplifier)
- Local input on amplifier: Enabled via software configuration or automatically selected

when amplifier address is set to address

**System channel 4 will be used as supervision channel in case local inputs are used.**

- Loop through on RJ45 connector (4channels)
- Build in Limiter
- AC Power switch on rearside
- 24V DC Input
- Front to rear air ventilation

#### Technical Specifications

<b>Rated load impedance (output power)</b>	
• 100V	20 $\Omega$ (500 W)
• 70V	10 $\Omega$ (500 W)
Rated output power, 1 kHz, THD $\leq$ 1%	2 $\times$ 500 W <sup>1</sup>
Rated input voltage	+6 dBu
<b>Max. RMS voltage swing, 1 kHz, THD <math>\leq</math> 1%, without load</b>	
• 100V	
• 70V	
<b>Voltage gain, ref. 1 kHz, fixed</b>	
• 70V	33.2 dB
• 100V	36.2 dB
Maximum load capacitance	2 $\mu$ F
Input level, max.	+18 dBu (9.75 V <sub>rms</sub> )
Frequency response, ref. 1 kHz, rated load, -3 dB	50 Hz to 25 kHz
Input impedance, active balanced	20 k $\Omega$
Signal-to-noise ratio (A-weighted)	> 104 dB
Output noise (A-weighted)	< -62 dBu
Crosstalk, ref. 1 kHz	< -85 dB
Output stage topology	Class-D, transformer, floating
<b>Power requirements</b>	
• AC	115–240 V(-10/+10%) <sup>2</sup>
• DC	21–32 V
Power consumption, AC and DC	See section “Power consumption” in operation manual

Inrush current	2 A
Inrush current, after five-second power cycle	1.3 A
Mains fuse	T6.3A (internally)
DC fuse	30A (internally)
Ground fault	$R < 50 \text{ k}\Omega$
CAN BUS port	2 × RJ-45, 10 to 500 kbit/s

Protection	Audio input level limiter, RMS output power limiter, high temperature, DC, short circuit, mains under voltage protection, DC supply under voltage protection, in rush current limiter, ground fault
Cooling	Front-to-rear, temperature- controlled fans
Operating temperature	-5 °C to +45 °C
Safety class	Class I
Electromagnetic environment	E1, E2, E3

- a. In DC mode and in continuous alarm-signal operation, output signal limited by 3dB max.
- b. Reduced output power at mains voltages below 115V

### Standards

- EN50130-4
- EN50581
- EN55103-1/2
- EN61000-3-2/3
- EN61000-6-3
- IEC60065
- EN60945

### Call Station

The call station shall be an EN54-16 compliant and certified user interface. It shall be designed in a modern and robust chassis with a graphical display.

As standard, the call station shall have a gooseneck microphone with pop shield and permanent monitoring, an illuminated LC-display and an integrated loudspeaker to be used for system sounds. The operation status shall be permanently supervised by the system controller.

It shall be possible to modify the call station to suit the user's requirements by connecting up to five remote call station keypads, each with 20 free customizable functions and selection buttons.



It shall be possible to extend the call station at the right and at the left side. It shall be possible to mount a maximum of 3 additional emergency buttons on the call station. Optionally it shall be possible to mount a key switch to lock or enable call station functions with a key switch or to give access to a second access level.

The call station shall have a built-in numerical keypad; it shall be possible to enable or disable the keypad during configuration.

The call station shall have the following specifications:

- Five menu/function keys (pre-programmed) – four buttons shall provide each 1 LED (2 LEDs shall be green and 2 LEDs shall be yellow).
- Green led on the microphone which is active during a call.
- 15 function and speed dial buttons (customizable), two LEDs (green/red) per button.
- Button functions shall be programmable such as:
- Zone select, source select, level control, emergency on/off, message on/off, failure acknowledge/reset.
- Switching output trigger on/off or 0 to 10V, select scheduled events, scheduled event on/off.
- Fascia cover with transparent areas for customizable labels.
- Multilanguage LCD display informs about system status, system faults, selected zones, source select, clock, different kind of additional (failure) messages shall be free configurable.
- Supervised electret microphone, with limiter and a speech filter for excellent speech intelligibility.
- CAT5 cable for data and audio connection to controller (CAN bus, up to 1000meter).
- It shall be possible to daisy chain 4 call stations.
- It shall receive audio and operational control signals from the controller and report its status to the system controller.
- Internal monitoring with error logging – complying with all relevant national and international standards.

### Technical Specifications

CAN BUS port	10, 20, or 62.5 kbit/s, 1× RJ-45, max. length 1000m
Maximum mic input level	-21 dBu
Maximum line input level	+4 dBu
Maximum NF output level	+12 dBu
Buttons	5 pre-programmed, 15 programmable zone/function keys
Color	RAL 9017 (traffic black)
Indicator lights	Power (green), Fault (yellow), Alarm (red) Green or yellow LED per pre-programmed menu button Green and red LED per
LC display	Back-lit LC display (122 × 32 pixel)

Ports	1 CST BUS port (Control data + Audio + Power supply, RJ-45)  1 audio source (line level, phone jack)
DC power input	15–58 V

**Standards:**

- – IEC60065
- – EN61000-6-3
- – EN50130-4

**2. ACCESS CONTROL SYSTEM****General Specification**

- OEM should be ISO 9001:2008, ISO 14001:2004, ISO 13485:2003 company (Need to submit ISO certificate) and comply the EU Directive 2002/95/EC on Restriction of Hazardous Substances (RoHS)
- Tenderers are advised that preference will be given to systems employing access control hardware, UHF reader and software design developed and manufacture by same OEM.
- Physical access to the premises is proposed to be controlled right from the main entry to the premises at the periphery level.
- The system should support seamless integration with CCTV & Fire Alarm Systems.
- Communication Speed - 9600, 19200, 57600, and 115200bps
- It is possible to issue maximum 15 cards per user under single user id to create uniformity in data base.
- DB format SQL Express Server 2012, password protected.
- DB Backup, Backup now option or clear all now option Complete DB export configuration or by event (selectable backup and restore) for easy set up and configuration.
- The system is intended to ensure situational awareness by displaying relevant information like events or devices in a Map.
- The access control system application software shall be client server architecture.
- Bidder has to submit OEM authorization letter to insure service and support.

**AC-225IP Specification**

- Description: 2 - reader - 2 door Intelligent IP Controller with **TWO READERS, FOUR RELAY OUTPUTS AND FOUR SUPERVISED INPUTS TO THE CONTROLLER.**

- Expandable to 4 Reader with 2 Reader Expansion Board
- **UL Listed**
- Microprocessor: 32Bit.
- Memory: 30000 User and 20000Logs
- Communication Protocol: Ethernet Port to connect to TCP/IP & RS 485 for downstream panels
- Card Holder Capacity : 30,000Min
- Event Buffer : 20,000Min
- Database Retention: Real-time clock keeps time for up to 2 weeks without power. No batteries to replace
- Inputs : 4 Supervised, dual-resistor, 2 state end-of-line inputs, Hi-impedance, active low 5 VDC  
8 supervised expandable inputs
- Outputs : 4 fully programmable 5 A, N.O. and N.C. relay outputs 4 expandable outputs
- Interface to Reader : 02 WiegandPort
- Operating Humidity: 0 to 85% (non-condensing).
- RFI Protection - > 20 V/m up to 1000MHz
- Operating temperature : 32°F to 120°F (0°C to 49°C)
- Wiegand Card Format : Two Wiegand 26/32/34/37/40 bit /C&D
- Facility Code: 08Min
- Operation Mode : Card Only/PIN Only/Card Or PIN/Card & PIN Selectable
- Anti pass back: Local & Global
- Regulatory Approvals :UL/CE/ROHS/TUV
- Cable cut tamper detection function for readers, and cover tamper detection for the enclosure
- Audio/Visual - Built-in sounder (Alarm, Chime, Bell), 11 on-board and 3 P.S.LEDs
- Controller shall also confirm the following Standard:

#### **CE(EU)**

- EMC:EN50130-4(95)+A1(98)+A2(03)EN55024:98+A1(01)+A2(03)
- EN61000-3-3:95+A1(01)RADIO: EN55022:98+A1(00)+A2(03)
- SAFETY: EN60950-1:2006,IEC60950-1:2005

#### **Software – Axtrax Ng – Access control management software**

##### **a. System Description**

- Software shall be based on a standard Client-Server architecture:
- The server connects to the database; the clients draw the information from the server.
- Clients connect to the server using a LAN remote communication.
- The server runs as a Windows service by default.
- The server operates using an SQL server 2012 database.
- The clients of the software is based on dynamic docking technology.
- The Software Access Control System is a user-friendly, intuitive, and rich in functionality. Using Software, you can configure door functionalities based on area and time frame for different types of personnel and for varying alarm situations.
- The Software Access Control System can integrate with Video management, a Video Surveillance software application. The main purpose of the integration is to enable

- video recording based on access control events and convenient play back.
- Badges can be designed form as sprinting and connectivity with digital cameras for image capture support.

#### **b. Functionality**

Software makes it possible to control and monitor every aspect of access on a site. The system includes a built-in software security system that controls access to the system database, and logs all performed operations. In addition, the system shall have the following features of professional grade:

- User-friendly PC software with intuitive layout reduces the complexity of access control
- Manages user data, photo and information fields, access rights, alarms, strike time, and door mode, all from one central location.
- Produces reports from acquired data, such as entry and exit times, as well as alarm types initiated by user, location, and time events
- Available in multiple languages and date formats
- Compatible with additional video management software modules
- Password controlled login in which it is possible to grant individually based restricted Security rights for different operators, with access to only specified elements of the system or with read-only access.
- The Software graphic user interface (GUI) shall allow users to configure, monitor, and control every aspect of a facility's access control network.
- When a user selects an element from the TreeView, its contents are shown in the main display area, and the toolbar icons change to suit the selected element.

The Software shall consist of the following major features:

##### **i. Intelligent Network Configuration**

- Monitors and configures all panels connected to the server with auto-detection
- Links between those devices connected to the panels
- Firmware upgrades

##### **ii. Camera Interaction**

- Real-time viewing of any camera
- Viewing recorded events
- Automated Video management camera activation options

##### **iii. Time Zone Management**

- Time Zones Door access rights, alarms, and input and output behavior can all be set to behave differently with in each time zone.
- Holidays–Sets special access behaviors for holiday time.

##### **iv. Group Management**

Each of the 5 kinds of groups (Access Groups, Access Areas, Output Groups, Input Groups, Card+ Card Groups) shall be configureable by the Software to provide features such as:

- Creating links between groups
- Assigning personnel to appropriate Access Groups to limit access to certain areas
- Dividing a facility into several Access Areas to configure and manage it more effectively. Each access area can be assigned an it passes backs rules to prevent one user's card or entry code from being used for two subsequent entries, and to prevent a second entry without a previous exit.
- Defining a set of inputs and outputs as Input and Output groups to control and manage them together with in a panel.
- Configuring Card+Card groups for access to high-security doors, which requires two users to present their cards in order to prevent entrance with a stolen card.

v. Car Parking Management

- Limits and controls the number of users who can access a specified area such as a parking area

vi. User Management

Each of the five elements (Departments/ Users, Visitors, User Filter, Cards, and Operators) shall be configurable by the Software:

- List of all departments and users, as well as any visitors registered in the system.
- Each user is assigned to a department for easier navigation between user properties.
- For each user, can assign cards and/ or a PIN code, set access rights, and include personal details and an identification photograph.
- User Filter to find users in the data base based on various search parameters, such as name, user number, and access group.
- List of all cards in the system with their statuses, allowing manual or automatic addition of cards to the system.

vii. Visitor Management

- Hosting department of the visitor and a list of all visitors registered in the system who can also be assigned specific access rights can be defined.
- Automatic Visitor Cards deactivation–After exiting the premises, the visitor card automatically becomes in active.
- Access Groups Authorization Removal–The designated access group changes to un authorized up on exit.

viii. Card Design (PhotoID)

- Create badges form assprinting.
- Design the background, size, colour and layout of the card.
- Add photo either from a file or from a PC camera.

#### ix. Various Reader Outputs

- Supports various pre-set Wieg and formats that can be chosen for the communication format between the proximity card reader and controller.
- A custom reader output format can also be created.
- Desktop enroller allows programming of transmission form at of Smart card readers.

#### c. Reports

Software can produce various reports, including usage reports, attendance records, visitors, and rollcalls. The Software Report Wizard shall allow users to design their own custom reports based on their needs.

- Software supports two report categories:
- **Immediate Reports**—List details of recent movements (within the last few hours). They are shown in the display are a and can be exported.
- **Archive Reports**—List all events in the data base

#### Immediate Reports

There are four types of immediate reports:

- **Who's been in today**—Lists where and at what time each user was granted access for the first time today.
- **Last known Position**—Lists where and at what time to day each user was most recently granted access.
- **Roll-Call Readers**—Lists the last time each reader was given access, and by whom, within the last 1–99hours.
- **Roll-Call Areas**—Lists all users currently within the selected area, sorted by department and entry time. The report lists all personnel who entered the facility within the last 1–99 hours.

#### i. Archive Reports

You can produce three types of archive reports:

- **Panels Event Reports**
- **System Software Events Reports**
- **Interactive Reports**  
Panels Events Reports  
Panel event reports display detail so fall recorded panel events. There are six available panel event reports:
- **Attendance Report**—Lists the attendance hours for selected users, sorted by date. Results include hours present, time in, and time out.
- **Panel's Report**—Lists all the events recorded by the selected panels, sorted by date.
- **Access Report**—Lists all access events recorded by the selected readers, sorted by reader and date.
- **Readers Report**—Lists all users who have accessed the selected readers, sorted by

department and date.

- **Finger print Report**–Lists specific finger prints reader's events, sorted by reader and date.
- **Visitors Report**–Lists visitors who have made a visit to a certain user or department, or lists all related visitors.

### **System Software Events Report**

System Software events reports list details of system and operator activity. There are three available system event reports.

- **System Report**–Lists all operations performed by the Software server, sorted by date.
- **Operators Report**–Lists all the operations performed by registered system operators, sorted by operation event type and date.
- **Alarm and Anitpass back Handler Report**– Lists all raised system alarms, sorted by operator and date.

### **Interactive Report**

Interactive reports list details of users and their access activity. There are two available interactive reports:

- **User Access Rights Report**–Lists site access details for selected users, with full details of readers accessed and in which time zones.
- **Not Responding Users Report**– Lists users for whom there have been no access events for a selected period of time.

### **Vitrax Video Integration Software – B Add on License need to consider base on number of camera to be integrate.**

- Digital video recording and remote surveillance client/server software for Microsoft® Windows.
- The software supports live view, video recording and playback from major brand IP cameras of multiple local and remote sites in multi-client/multi-server installations, enabling the export of digital recordings for storage.
- DVR Watchdog Recovery – Restarts the server automatically to resume local and remote data flow providing high level of reliability.
- Multi-Server, Multi-Client Support – Supports an unlimited number of cameras connected to the IP network on any geographical area. Proprietary Multi-media Database – Provides compact storage and efficient export of selected recordings for evidence preservation (own metadata).
- Real-time multi-channel streaming video – ISO MPEG-4, Intel IPP, and Direct Show formats for effective compression and bandwidth savings
- Support for console multi-screen viewing – Advanced OSD control and presence triggered by access control systems.
- Full support of all video parameters such as frame per second (fps), bit rate resolution, brightness and contrast; support up to 64 preset locations for PTZ cameras".
- The VMS shall support interoperability with IP camera standards including, at a

minimum, the Open Network Video Interface Forum (ONVIF).

- When a camera is linked to Software, video events can be linked to access control events and viceversa.
- The customer can select the source, destination, and period of recordings using Conditioned Recording sequences programmed via the Panel Links screen.
- In the Camera Properties window, the customer can view live streaming, view recorded events, and edit various camera properties.
- The following properties of the Video management can be controlled and changed by the customer:
  - Motiondetector
  - Timelapse
  - Framerate
  - Live audiovolume
  - Audio tocamera
  - Microphone device
  - Cameraproperties
  - PC archive
  - Localarchive
  - Snapshot

### 3. CCTV System

#### Technical Specifications:

<b><u>DOME CAMERA</u></b>		
<b>General Specification</b>	<b>Technical Specification</b>	<b>Compliance (Yes / No)</b>
<b>Camera</b>		
Sensor	1/3", progressive scan, 4.0 megapixel, CMOS	
Lens	2.8~12 mm, AF automatic focusing and motorized zoom lens	
Angle of View (H)	91.0°~27°	
Angle of View (V)	54.4°~13.7°	
Angle of View (O)	118.3°~33.2°	
Adjustment angle	Pan: 0°~360°	
	Tilt: 0°~90°	
	Rotate: 0°~360°	
Shutter	Auto/Manual, 1 ~ 1/100000s	
Minimum Illumination	Colour: 0.005 Lux (F1.4, AGC ON) 0 Lux with IR	
Day/Night	IR-cut filter with auto switch (ICR)	



Digital noise reduction	2D/3D DNR	
S/N	>55 dB	
IR Range	Up to 30m (98 ft) IR range	
Defog	Digital Defog	
WDR	120dB	
<b>Video</b>		
Video Compression	Ultra 265,H.265, H.264,MJPEG	
H.264 code profile	Baseline profile, Main Profile, High Profile	
Frame Rate	Main Stream:4MP(2592×1520): Max. 20 fps, 4MP(2560×1440): Max. 25 fps, 3MP(2048×1520): Max. 30 fps; Sub Stream:2MP (1920×1080): Max. 30 fps; Third Stream:D1(720×576) : Max. 30fps	
HLC	Supported	
BLC	Supported	
9:16 Corridor Mode	Supported	
OSD	Up to 8 OSDs	
Privacy Mask	Up to 8 areas	
ROI	Up to 8 areas	
Motion Detection	Up to 4 areas	
<b>Audio</b>		
Audio Compression	G.711	
Two-way audio	Supported	
Suppression	Supported	
Sampling Rate	8 KHZ	
<b>Storage</b>		
Edge Storage	Micro SD, up to 256 GB	
Network Storage	ANR	
<b>Network</b>		
Protocols	IPv4, IGMP, ICMP, ARP, TCP, UDP, DHCP, PPPoE, RTP, RTSP, RTCP, DNS, DDNS, NTP, FTP, UPnP, HTTP, HTTPS, SMTP, 802.1x, SNMP	
Compatible Integration	ONVIF(Profile S, Profile G), API	
<b>Interface</b>		
Audio I/O	Audio cable	

	Input: impedance 35 k $\Omega$ ; amplitude 2 V [p-p]	
	Output: impedance 600 $\Omega$ ; amplitude 2 V [p-p]	
Alarm I/O	(1/1)	
Network	1 RJ45 10M/100M Base-TX Ethernet	
Video Output	1 BNC, impedance 75 $\Omega$ ; amplitude 1 V [p-p]	
<b>General</b>		
Power	DC12V $\pm$ 25%, PoE (IEEE802.3 af)	
	Power consumption: Max 7.2 W	
Dimensions ( $\varnothing$ x H)	$\varnothing$ 148 x 111.3 mm ( $\varnothing$ 5.8" x 4.4")	
Weight	0.75 kg (1.7 lb)	
Working Environment	-40°C ~ +60°C (-40°F ~ 140°F), Humidity: 10% ~ 95% RH (non-condensing)	
Ingress Protection	IP67	
Vandal Resistant	IK10	
Reset Button	Supported	
Certification	UL, RoHS, CE, FCC, IP67, IK10, LAB TEST Reports	
<b>BULLET CAMERA</b>		
<b>Item</b>	<b>Minimum Specification</b>	<b>Compliance (Yes/No)</b>
Sensor	1/2.8", progressive scan, 4.0 megapixel, CMOS	
Lens	2.8~12mm, AF automatic focusing and motorized zoom lens	
Angle of View(H)	91° ~ 27°	
Angle of View (V)	54.4° ~ 13.7°	
Angle of View (O)	118.3° ~ 33.2°	
Adjustment angle	Pan: 0° ~ 360° Tilt: 0° ~ 90° Rotate: 0° ~ 360°	
Shutter	Auto/Manual, 1~1/100000 s	
Minimum Illumination	Colour: 0.001 Lux (F1.4, AGC ON) 0 Lux with IR on	
Day/Night	IR-cut filter with auto switch (ICR)	
Digital noise reduction	2D/3D DNR	
S/N	>52 dB	
IR Range	Up to 50m (164 ft) IR range	

Defog	Digital Defog	
WDR	120dB	
<b>Video</b>		
Video Compression	Ultra 265,H.265, H.264, MJPEG	
H.264 code profile	Baseline profile, Main Profile, High Profile	
Frame Rate	Main Stream:4MP (2592×1520): Max. 20 fps , 4MP (2560×1440): Max. 25 fps, 3MP (2048×1520): Max. 30 fps; Sub Stream:2MP (1920×1080): Max. 30 fps; Third Stream:D1(720×576) : Max. 30fps	
9:16 Corridor Mode	Supported	
HLC	Supported	
BLC	Supported	
OSD	Up to 8 OSDs	
Privacy Mask	Up to 8 areas	
ROI	Up to 8 areas	
Motion Detection	Up to 4 areas	
<b>Smart</b>		
Behavior Detection	Intrusion, cross line, motion detection	
Intrusion	Enter and loiter in a pre-defined virtual region	
cross line	Cross a pre-defined virtual line	
motion detection	Moving within a pre-defined virtual region	
Recognition	Face detection Audio detection	
Intelligent Identification	Defocus, Scene Change, Object Left, Object Moving	
Statistical Analysis	People counting	
General Function	Watermark, IP Address Filtering, Tampering Alarm, Alarm input, Alarm output, Access Policy, ARP Protection, RTSP Authentication, User Authentication	
<b>Audio</b>		
Audio Compression	G.711	
Two-way audio	Supported	
Suppression	Supported	
Sampling Rate	8 KHZ	

Storage		
Edge Storage	Micro SD, up to 256 GB	
Network Storage	ANR	
Network		
Protocols	IPv4, IGMP, ICMP, ARP, TCP, UDP, DHCP, PPPoE, RTP, RTSP, RTCP, DNS, DDNS, NTP, FTP, UPnP, HTTP, HTTPS, SMTP, 802.1x, SNMP	
Compatible Integration	ONVIF(Profile S, Profile G, Profile T), API	
Interface		
Audio I/O	Audio cable Input: impedance 35 k $\Omega$ ; amplitude 2 V [p-p] Output: impedance 600 $\Omega$ ; amplitude 2 V [p-p]	
Alarm I/O	(1/1)	
Network	1 RJ45 10M/100M Base-TX Ethernet	
General		
Power	12 V DC $\pm$ 25%, PoE (IEEE802.3 af) Power consumption: Max 9W	
Dimensions (L $\times$ W $\times$ H)	253.4 $\times$ 86 $\times$ 71.7 mm (9.98" $\times$ 3.4" $\times$ 2.8")	
Weight	1.0 kg (2.2 lb)	
Working Environment	-35°C $\sim$ +60°C (-31°F $\sim$ 140°F), Humidity:10%~95% RH(non-condensing)	
Ingress Protection	IP67	
Certificate	UL,FCC,CE,IP67,IK10	

PTZ CAMERA		
General Specification	Technical Specification	Compliance (Yes / No)
Camera		
Sensor	1/1.8", 4.0 megapixel, progressive scan, CMOS	
Lens	5.7 $\sim$ 216.6mm, AF automatic focusing and motorized zoom lens	
Digital Zoom	16	
Optical Zoom	38	
Angle of View (H)	58.5° $\sim$ 2.1°	
Angle of View (V)	34.9° $\sim$ 1.2°	

Angle of View (O)	72.0° ~ 2.5°	
Shutter	Auto/Manual; shutter time: 1 ~ 1/100000s	
Minimum Illumination	Colour: 0.0005Lux (F1.3, AGC ON) 0Lux with IR	
Iris	Auto/Manual; F1.3 ~ F4.6	
Day/Night	R-cut filter with auto switch (ICR)	
Digital noise reduction	2D/3D DNR	
S/N	>55dB	
IR Range	UP to 250m (820ft)	
Defog	Optical Defog & Digital Defog	
WDR	120dB	
<b>Video</b>		
Video Compression	Ultra 265, H.265, H.264, MJPEG	
H.264 code profile	Baseline profile, Main Profile, High Profile	
Frame Rate	Main Stream: 4MP (2688*1520), Max 60fps; Sub Stream: 2MP (1920*1080), Max 60fps; Third Stream: D1 (720*576), Max 60fps	
HLC	Supported	
BLC	Supported	
EIS	Supported (Gyroscope)	
OSD	Up to 8 OSDs	
Privacy Mask	Up to 24 areas	
ROI	Up to 8 areas	
Motion Detection	Up to 4 areas	
<b>Audio</b>		
Audio Compression	G.711	
Two-way audio	Supported	
Suppression	Supported	
Sampling Rate	8KHZ	
<b>Storage</b>		
Edge Storage	Micro SD, up to 256GB	
Network Storage	ANR	
<b>Network</b>		

Protocols	IPv4, IGMP, ICMP, ARP, TCP, UDP, DHCP, PPPoE, RTP, RTSP, RTCP, DNS, DDNS, NTP, FTP, UPnP, HTTP, HTTPS, SMTP, 802.1x, SNMP, QoS	
Compatible Integration	ONVIF (Profile S, Profile G, Profile T), API	
<b>Pan &amp; Tilt</b>		
Pan Range	360° (endless)	
Pan Speed	0.1°/s ~ 74°/s	
	Preset speed: 300°/s	
Tilt Range	-20° ~ 90° (auto reverse)	
Tilt Speed	0.1° ~ 74°/s	
	Preset speed: 240°/s	
Number of Presets	1024	
Patrol	Preset patrol, route patrol, recorded patrol	
Home Position	Supported	
<b>Interface</b>		
Audio I/O	Audio cable	
	Input: impedance 1kΩ; amplitude 2V [p-p]	
	Output: impedance 600Ω; amplitude 2V [p-p]	
Alarm I/O	(2/1)	
Serial Port	1 RS485	
Network	1 RJ45 10M / 100M Base-TX Ethernet	
<b>General</b>		
Power	AC 24V ±25%, DC 24V ±25%, PoE++ (IEEE 802.3bt) (IEEE802.3bt switch required)	
	Power consumption: 16 ~ 51W	
Dimensions (Ø x H)	Φ270 x 496.7mm (Φ10.6" x 19.6")	
Weight	9.69kg (21.4lb)	
Working Environment	-40°C ~ 70°C (-40°F ~ 158°F), Humidity: ≤95% RH (non-condensing)	
Ingress Protection	IP66	
Reset Button	Supported	

<b>NVR SYSTEM</b>		
<b>General Specification</b>	<b>Technical Specification</b>	<b>Compliance (yes/no)</b>
<b>Video/Audio Input :</b>		
IP Video Input	32-ch	
Two-way Audio Input	1-ch, RCA	
<b>Network :</b>		
Incoming Bandwidth	320Mbps	
Outgoing Bandwidth	320Mbps	
Remote Users	128	
Protocols	IPV4, IPV6, SNMP,P2P, UPnP, NTP, DHCP, PPPoE, HTTP, SMTP, TCP/IP, RTSP	
HDMI/VGA Output	HDMI1 VGA : 1920x1080p /60Hz, 1920x1080p /50Hz, 1600x1200 /60Hz, 1280x1024 /60Hz, 1280x720 /60Hz, 1024x768 /60Hz HDMI2:	
	HDMI2 : 4K (3840x2160) /60Hz, 4K (3840x2160) /30Hz, 1920x1080p /60Hz, 1920x1080p /50Hz, 1600x1200 /60Hz,1280x1024 /60Hz, 1280x720 /60Hz, 1024x768 /60Hz	
CVBS Output	1-ch, BNC	
Recording Resolution	12MP/8MP/6MP/5MP/4MP/3MP/1080p/960p/720p/ D1/2CIF/CIF	
Audio Output	1-ch, RCA	
Synchronous Playback	16-ch	
Corridor Mode Screen	3/4/5/7/9/10/12/16/32	

Decoding format	Ultra 265, H.265, H.264	
Live view/ Playback	12MP/8MP/6MP/5MP/4MP/3MP/1080p/960p/720p/ D1/2CIF/CIF	
Capability	3 x 12MP@25, 4 x 4K@30, 8 x 4MP@30, 16 x 1080P@30, 32 x 960P@25, 36 x 720P@30, 64 x D1	
<b>Hard Disk :</b>		
SATA	8 SATA interfaces	
Capacity	up to 10TB for each HDD	
eSATA	1 eSATA interface	
VCA Detection	Face detection, Intrusion detection, Cross line detection, Audio detection, Defocus detection, Scene change detection, Auto tracking	
VCA Search	Face search, Behavior search	
Statistical Analysis	People counting	
Array Type	RAID 0, 1, 5, 6, 10	
Network Interface	2 RJ45 10M/100M/1000M self-adaptive Ethernet Interfaces	
Serial Interface	1 x RS232, 1 x RS485	
USB Interface	Front panel: 2 x USB2.0,Rear panel: 1 x USB3.0	
Alarm In	16-ch	
Alarm Out	4-ch	
Power Supply	100 ~ 240 VAC	



	Power Consumption: $\leq 20$ W( without HDD )	
Working Environment	-10°C ~ + 55°C ( +14°F ~ +131°F ), Humidity $\leq 90\%$ RH(non-condensing)	
Dimensions(W×D×H)	442mm ×425mm× 86mm (17.4" × 16.7"× 3.4")	
Weight ( without HDD)	$\leq 5.13$ Kg (11.31 lb )	
Certification	CE, FCC, ISO9001, ISO14001	

#### 4. IT-Passive

##### Technical Specification

##### A) Cat 6A (U/UTP) Indoor Cable.

	Minimum Specifications	Compliance Yes/No	rk
<b>1</b>	<b>UTP Cable, TIA-568C.2, Category-6A (U/UTP), (305 Mtrs./1000 feet per Box)</b>		
1.1	This cable well exceeds the requirements of Category 6 Unshielded Twisted Pair 4 pair cable shall be compliant with ANSI/TIA/EIA-568-C.2 channel performance & IEC/ISO 11801		
1.2	Construction: 4 twisted pairs separated by internal X shaped, 4 channel, polymer spine / full separator. Half shall not be accepted.		
1.3	The 4 pair Unshielded Twisted Pair cable shall be ETL Verified.		
1.4	Conductor Solid bare Copper and Jacket LSZH with RIP cord		
1.5	Insulation :High Density Polyethylene		
1.6	Dielectric Strength of cable should be 1.0KV dc		
1.7	The cable should comply to Flammability Test – IEC 60332-1 Acid Gas Emission Test – IEC 60754 - 1 & 2, Smoke Density Test – IEC 61034-2		
1.8	Bending Radius should be 8xCable Diameter while pulling and Pulling Force: 11.5 Kg		
1.9	Nominal Outer Diameter of Cable should be 6.1 mm Nominal and Conductor Diameter (23 AWG)		

1.10	Cable should support operating Temperature from -20° to +70°C		
1.11	Cable should come with printed sequential Length Counter on each meter		
1.12	Cable support Conductor Resistance < 9.38 $\Omega$ /100m		
1.13	Mutual Capacitance of cable should be < 5.6nF/100m		
1.14	Max Resistance Unbalance of cable should be 5% Max		
1.15	Capacitance Unbalance of cable should max 330pF/100m		
1.16	Cable support Delay Skew: < 45nS, Operating Voltage: 72V and NVP: 69%		
1.17	Category 6 UTP cables shall Supports Gigabit Ethernet (1000 base-T) standard and Operates at bandwidth of 250 MHz.		

**B) Faceplate Single with Mounting/GangBox**

S. No.	Minimum Specifications	Compliance Yes/No	Remark
<b>1</b>	<b>Faceplate Simplex</b>		
1.1	Shall be Single Port or Dual port (RJ45) square plate, dimension as per commercially available modular office furniture.		
1.2	Shall have spring shuttered front access for preventing ingress of dust		
1.3	Face Plate Shall be supplied with Gang Box of the same OEM if manufactured by OEM or equivalent Brand (Legrand, Anchor & Havells) if not manufactured by OEM.		
1.4	Shall have Write on labels in transparent plastic window along with the plate		
1.5	Shall have Screw hole covers along with the plate		
1.6	Shall be able to support variety of jacks (Cat6 & Cat6A) – UTP and STP Information outlets		

**C) UTP/FTP Patch Panel 24 ports unloaded multipurpose for Cat6 Jack**

S. No.	Minimum Specifications	Compliance Yes/No	Remark
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<b>1</b>	<b>UTP Jack Panel, Unloaded with Individual Replaceable Jack 24 nos. UTP ports for PCB based IO Jacks</b>		
1.1	Shall be unloaded individually replaceable 24 nos. Category-6 I/O Jacks complying with TIA-568.C		
1.2	Shall be 19" rack mountable and of 1U height & complete with all mounting accessories. Shall be UL Listed, ETL Verified and RoHS Compliance.		
1.3	Shall have labels for identification of ports		
1.4	Shall have Comprehensive port numbering on front		
1.5	Accommodate both 24 & 48 ports for each rack mount space.		
1.6	Come equipped with integrated rear wire management system		

**D) Information Outlet (I/O) RJ45CAT6**

<b>S. No.</b>	<b>Minimum Specification</b>	<b>Compliance Yes/No</b>	<b>Remark</b>
1	Information Outlet (I/O) RJ45 CAT6		
1.1	I/O Jack should be Category 6, TIA568B.2-1 – 250MHz		
1.2	I/O Jack should be for 100 – 24 AWG copper cable shall: Use insulation displacement connectors (IDC)		
1.3	I/O Jack should allow for a minimum of 200 re-terminations without signal degradation below standards compliance limits.		
1.4	I/O Jack should be constructed of high impact, flame-retardant thermoplastic with colour and icon options for better visual identification.		
1.5	Information outlet (RJ45 jack) should be covered under ETL Verification program for compliance with TIA568B.2-1, ETL certificate to be submitted with offer.		
1.6	Plastic Housing: Polycarbonate, UL94V-0 rated or equivalent.		
1.7	Operating Life: Minimum 750 insertion cycles.		
1.8	Contact Material: Copper alloy.		
1.9	IDC Contact Plating: Tin Plate (tin/lead)		

**E) Cat 6 UTP/FTP Patch Cord 1 Mtr and 2 Mtr.**

S. No.	Minimum Specifications	Compliance Yes/No	Remark
<b>1</b>	<b>Cat 6 UTP/FTP Patch Cable, TIA-568C Category-6</b>		
1.1	Cat6 patch cords should be high quality four pair twisted stranded cable terminated with RJ45 tangle free modular plugs at both the ends.		
1.2	The patch cord should be with TIA/EIA-568-C.2 standard.		
1.3	The Conductor should be 24 AWG, Multi-strands & Bare Copper Conductor Metal		
1.4	The Insulation Material of the cable is made of HDPE with FR PVC		
1.5	The Heat Resistance of the cable is 60 °C minimum (Temperature limited)		
1.6	The Insertion Cycles of the cable is 750 times		
1.7	The Modular connector/Plug should made of transparent ABS		
1.8	The Contact Tip Should have 50 micro inches of gold plating over nickel contacts.		
1.9	Should be covered by ETL verification program or UL listed for compliance with TIA 568B.2-1. Certificate to be submitted with bid.		

**F) 6 Core MM Fiber Cable**

		<b>06 CORE FIBER CABLE SPECIFICATION</b>	Compliance Yes/No	Remark
1.1	Cable Type	6-core, Multi-Mode HDPE Sheath, Armored, loose-tube, Uni Tube, CST armour, Gel Filled		
1.3	No. of cores	6		
	Cable Type	OM4		
	Attenuation			
	@1310nm	< = 0.36 dB/Km		
	@1550nm	< = 0.22 dB/Km		
	Tensile rating	1000N		
	Maximum Crush resistance	2000N		

	Operating Temperature	-10 Degree C to +60 Degree C		
	Armor	Corrugated Steel tape Armor for anti - termite, anti - rodent		
	Colour	Natural		
	Outer jacket	High density polyethylene		
	Secondary Buffer Material	Gel filled Loose Tube.		
	Loose Tube Outer Dia	1.9 mm +/-0.1mm		
	Cable Weight	75 +/- 20 KG per KM		
	Min Bend	20 XD		
	Marking	Identification marking at regular intervals of 1 meter		
	Length of cable drum	standard factory length and can be supplied is max 4 Kms		
<b>2</b>		<b>12 Port &amp; 48 port LIU</b>	<b>Compliance Yes/No</b>	<b>Remark</b>
2.1		Rack Mount Sliding Fiber Panel is essentially a fiber distribution box wherein the fiber cables and the equipment cables are terminated and managed. This panel is unloaded (with no blank plate by default). It can accept optional 4 blank plates or adaptor plates with choice of SC, LC, ST, FC. Splice tray is pre-installed to support fusion splicing on site. Sliding mechanism ease the installation. Together they function as an excellent interfacing unit for cables coming in from field and those originating from the equipments, providing cross-connection capability.		
2.2	Material	Powder Coated Aluminium Alloy		
2.3	Dimensions (HxWxD)	U: 44 x 482 x 330mm		
2.4	Max. fibercount	U: 24 fibers (SC), 48 fibers (LC)		

2.5	Fusion Tray & Cable Disc	BS Plastic Grey		
2.6	Fusion Capacity	4 Fiber (Max) Per Splice Tray		
2.7	Heat ShrinkTube	E + EVA Plastic (Transparent)		
<b>3</b>		<b>Fiber Pigtaills</b>	<b>Compliance Yes/No</b>	<b>Remark</b>
3.1	Outer Diameter	.6mm Simplex		
3.2	Minimum Cable Retention Strength 1.6mm	1.24 lbs (50N)		
3.3	Jacket			
<b>4</b>		<b>Fiber Patch Cords</b>	<b>Compliance Yes/No</b>	<b>Remark</b>
4.1	Outer Diameter	.6mm x 3.0mm (Duplex)		
4.2	Minimum Cable Retention Strength 1.6mm	1.24 lbs (50N)		
4.3	Jacket	SZH		
4.4	Operating Temperature	10°C~ +60°C		
	TYPE	C to SC) 3m - OM4 50/125		

## 5. NETWORK RACKS

### Technical Specification for (Network Rack)

S. No.		Minimum Specifications	Compliance Yes/No	Remark
<b>1</b>		<b>27U Rack - Cabinet</b>		
1.1	Basic Structure	Four Pillars of CRCA Steel Folded		
1.2	Top & Bottom Cover	Bolted to Frame With Cable entry exit cut outs		
1.3	Construction	Welded or CKD		

1.4	Doors Front	Lockable Glass Door OR Lockable Perforated steel Door		
1.5	Doors Rear	Lockable Steel Door Plain/Perforated		
1.6	Colour	Black or Light Grey		
1.7	Standard Finish	Powder Coated as Per Required, Colour (Black, Light Grey)		
1.8	Certifications	DIN- 41494,EIA-310,IEc-60297		
1.9	Load Bearing Capacity	750 Kg with caster & 1250 Kg with levelers/Plinth		
1.10	Ordering Information	Height-27U, Width 600 MM & Depth 600MM		
<b>2</b>	<b>42 U Rack - Cabinet</b>			
2.1	Basic Structure	Four Pillars of CRCA Steel Folded		
2.2	Top & Bottom Cover	CRCA Steel Sheet		
2.3	Side Panel	CRCA Steel Sheet		
2.4	Doors Front & Rear	Option Hex Perforated (Single or Double		
2.5	Construction	Bolted Construction		
2.6	Colour	Black or Light Grey		
2.7	Standard Finish	Powder Coated (RAL 7035)		
2.8	Certifications	DIN- 41494,EIA-310,IEc-60297		
2.9	Load Bearing Capacity	500 Kg with caster & on base Frame 750 Kg		
2.10	Ordering Information	Height-42U, Width 800 MM & Depth 1000MM		
<b>3</b>	<b>15 U Rack - Cabinet</b>			
3.1	Basic Structure	Four Sides of CRCA Steel		
3.2	Top & Bottom Cover	CRCA Steel Sheet		
3.3	Construction	Welded		
3.4	Colour	Standard Light Grey		
3.5	Standard Finish	Powder Coated (RAL 7035)		
3.6	Certifications	DIN- 41494,EIA-310,IEc-60297		
3.7	Load Bearing Capacity	40 KG		
<b>4</b>	<b>9U Rack - Cabinet</b>			
4.1	Basic Structure	Four Sides of CRCA Steel		
4.2	Top & Bottom Cover	CRCA Steel Sheet		
4.3	Construction	Welded		

4.4	Colour	Standard Light Grey		
4.5	Standard Finish	Powder Coated (RAL 7035)		
4.6	Certifications	DIN- 41494,EIA-310,IEc-60297		
4.7	Load Bearing Capacity	30 KG		

## 6. IT –Active

### MINIMUM TECHNICAL SPECIFICATIONS FOR IT ACTIVE SYSTEM IT ACTIVE SYSTEM

#### i. Specification for 24 Port Access Switch POE+:-

S.No	Standard Compliance	Compliance (Yes/No)
	<b>Performance</b> The unit shall have the following minimum specification.	
1	Minimum 24 x 10/100/1000 Base-T PoE+ and 4 x 1/10G ports. (with required transceiver modules)	
2	1 U Rack mountable and should provide stacking of minimum 10 switches with 160Gbps of dedicated stacking/ equivalent bandwidth (All the stacking accessories should be included from day 1).	
3	The Switch should have 2GB DRAM and 2GB internal Flash	
4	246 Gbps or higher Backplane capacity and minimum 190 Mpps of forwarding rate	
5	Should support Non-blocking hardware architecture	
6	All interfaces should provide wire speed forwarding for both Fiber and copper modules	
7	Support for at least 2000 VLANs & 32k MAC address	
8	It should support IGMP snooping v1,v2 & v3	
9	It should have static IP routing from Day 1 and should be upgradable to support OSPF and PIM	
10	Switch should support 8 hardware queues per port	
11	Dynamic Host Configuration Protocol (DHCP) snooping	
12	Switch should support LLDP capabilities	
13	Should support IP Source Guard , DAI and IPv6 Security feature like IPv6 RA Guard and IPv6 Neighbor Discovery Inspection	
14	Should support Secure Shell (SSH) Protocol and Simple Network Management Protocol Version 3 (SNMPv3).	
15	Switch needs to have console port for administration & management	
16	Management using CLI, GUI using Web interface should be supported	
17	FTP/TFTP for upgrading the operating System	
18	Should support Energy Efficient Ethernet	
19	IEEE 802.1x support	



20	IEEE 802.1D Spanning-Tree Protocol	
21	IEEE 802.1p class-of-service (CoS) prioritization	
22	IEEE 802.1Q VLAN	
23	IEEE 802.3 10BASE-T specification	
24	IEEE 802.3u 100BASE-TX specification	
25	Switch should have internal redundant power supply and Hotswappable fans	
26	Switch should able to support management via CLI, Web interface	
27	SNMP v1,v2,v3	
28	Switch should be manageable through both IPv4 & IPv6.	
29	Switch should be UL-UL60950-1,FCC Part 15, VCCI Class A, EN 55022, EN 55024, EN 300386, CAN/CSA 22.2 No.60950-1, Reduction of Hazardous Substances (ROHS) certified	
30	Switch should be IPv6 Logo Certified	
31	Switch Should be Common Criteria NDPP/NDcPP certified	
32	OEM should be leader in Gartner Report for Data Centre networks.	

ii. **Specification for 24 Port Access Switch: -**

	<b>Standard Compliance</b>	<b>Compliance (Yes/No)</b>
	<b>Performance</b> The unit shall have the following minimum specification.	
1	Minimum 24 x 10/100/1000 Base-T and 4 x 1/10G ports. (with required transceiver modules)	
2	1 U Rack mountable and should provide stacking of minimum 10 switches with 160Gbps of dedicated stacking/ equivalent bandwidth (All the stacking accessories should be included from day 1).	
3	The Switch should have 2GB DRAM and 2GB internal Flash	
4	246 Gbps or higher Backplane capacity and minimum 190 Mpps of forwarding rate	
5	Should support Non-blocking hardware architecture	
6	All interfaces should provide wire speed forwarding for both Fiber and copper modules	
7	Support for at least 2000 VLANs & 32k MAC address	
8	It should support IGMP snooping v1,v2 & v3	
9	It should have static IP routing from Day 1 and should be upgradable to support OSPF and PIM	
10	Switch should support 8 hardware queues per port	
11	Dynamic Host Configuration Protocol (DHCP) snooping	
12	Switch should support LLDP capabilities	

13	Should support IP Source Guard , DAI and IPv6 Security feature like IPv6 RA Guard and IPv6 Neighbor Discovery Inspection	
14	Should support Secure Shell (SSH) Protocol and Simple Network Management Protocol Version 3 (SNMPv3).	
15	Switch needs to have console port for administration & management	
16	Management using CLI, GUI using Web interface should be supported	
17	FTP/TFTP for upgrading the operating System	
18	Should support Energy Efficient Ethernet	
19	IEEE 802.1x support	
20	IEEE 802.1D Spanning-Tree Protocol	
21	IEEE 802.1p class-of-service (CoS) prioritization	
22	IEEE 802.1Q VLAN	
23	IEEE 802.3 10BASE-T specification	
24	IEEE 802.3u 100BASE-TX specification	
25	Switch should have internal redundant power supply and Hotswappable fans	
26	Switch should able to support management via CLI, Web interface	
27	SNMP v1,v2,v3	
28	Switch should be manageable through both IPv4 & IPv6.	
29	Switch should be UL-UL60950-1,FCC Part 15, VCCI Class A, EN 55022, EN 55024, EN 300386, CAN/CSA 22.2 No.60950-1, Reduction of Hazardous Substances (ROHS) certified	
30	Switch should be IPv6 Logo Certified	
31	Switch Should be Common Criteria NDPP/NDcPP certified	
32	OEM should be leader in Gartner Report for Data Centre networks.	

iii. **Specification for 10G SFP Module:-**

	<b>Standard Compliance</b>	<b>Compliance (Yes/No)</b>
	<b>Performance</b> The unit shall have the following minimum specification.	
	10G Ethernet SFP+ Module, 850nm, MMF upto 300m, LC	

iv. **Specification for 10G Ethernet SFP+ passive cable assembly, 1m:-**

	<b>Standard Compliance</b>	<b>Compliance (Yes/No)</b>
	<b>Performance</b> The unit shall have the following minimum specification.	
	<b>10G Ethernet SFP+ passive cable assembly, 1m</b>	

v. **Specification for 10G Ethernet SFP+ passive cable assembly, 3m:-**

	Standard Compliance	Compliance (Yes/No)
	<b>Performance</b> The unit shall have the following minimum specification.	
	<b>10G Ethernet SFP+ passive cable assembly, 3m</b>	

vi. **Specification for Wireless Controller:-**

	Standard Compliance	Compliance (Yes/No)
	<b>Performance</b> The unit shall have the following minimum specification.	
1	Should have a Artificial Intelligence (AI) driven, Micro Services Based Controller (On Prem or Cloud)	
2	The Solution should support 802.11ac primarily and should be backward compatible to 802.11n/a/b/g. The solution should also support 802.11ax as per requirement.	
3	The solution should support Location Based services via Bluetooth low energy and should also support Asset Tracking.	
4	The solution should support Guest Portal	
5	The solution should support WIPS, Rouge AP detection and Honeypot AP detection	
6	Should be able to provide insights based on Time to connect, successful connect, coverage, capacity, AP Uptime, Roaming and throughput.	
7	should be able to integrate with various authentication mechanism including the RADIUS servers, etc.	
8	Should support Dynamic Packet capture to enhance troubleshooting.	
9	Should support upto 16 SSIDs per AP and the cloud controller should be scalable to handle around 5000 APs or more in future	
10	Should have a virtual assistant to troubleshoot deeper and facilitate investigation of existing or future issues in the Wi-Fi network	
11	Must be able to limit per SSID based uplink or downlink Bandwidth	
12	Must be able to limit per user based uplink or downlink bandwidth	
13	Must be able to provide per application bandwidth limit as well	
14	The per application based Bandwidth limit should be applicable on Home Grown or Organization specific applications as well	
15	Pre-staging of APs should be possible to have zero touch provisioning	
16	Should support bulk configuration based on templates	
17	Should be able to handle interference and shift the communication on another channel automatically if needed	
18	Should be able to create access policies based on various groups/labels/subnets	

19	Should be able to extend API to integrate with other systems as well.	
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vii. **Specification for Indoor Access Point:-**

	Standard Compliance	Compliance (Yes/No)
	<b>Performance</b> The unit shall have the following minimum specification.	
1	AP must support the 802.11a/b/g/n/ac /ax	
2	Simultaneous client support on dual band radio is essential.	
3	Must support minimum 4X4:4 MU-MIMO on atleast 5Ghz Band	
4	All the access points must be centrally configured and managed through the same OEM cloud controller / On Prem Controller and should support AI Based network operations.	
5	Access Point must support aggregate data rate of minimum 2.9 Gbps (2.4 Gbps on 5 GHz and 500 Mbps on 2.4 GHz).	
6	Security mechanisms must be in place to protect the communication between the Management Platform and the Access Points.	
7	AP must be supplied with all accessories including the appropriate mounting kit.	
8	The antennas must be integrated inside the access point enclosure.	
9	The access point must support 802.1q VLAN tagging	
10	The access point must support WPA2/WPA3 enterprise authentication and AES encryption. AP must support Authentication via 802.1X and Active Directory.	
12	Operating Temperature: 0°C - 40°C	
13	Operating Humidity: 10 % - 90 % non-condensing.	
14	Must be plenum rated (UL 2043) and comply to RoHS	
15	Must be WPC approved	
16	Wireless solution must have WIPS, Rogue AP detection and Honey pot AP detection	
17	Wireless Solution must support Guest portal.	
18	Access Point should have inbuilt BLE radio.	
19	The AP should have at least one RJ-45 ports and, should be able to support up to 2.5Gbps port speed.	
20	The AP should have a dedicated Radio for Spectrum Analysis and Rogue Detection	
21	The AP should be able to service client as well as rogue detection simultaneously.	

viii. **Specification for Network Management Solution:-**

	<b>Standard Compliance</b>	<b>Compliance (Yes/No)</b>
	<b>Performance</b> The unit shall have the following minimum specification.	
1	The proposed solution should be premise based and not cloud based. This should be based on standard server (Physical/Virtual)	
2	Redundant solution shall be proposed. The centralized management function shall allow to display the physical topology of the network.	
3	The centralized management function shall be able to handle wired equipment (switches) and wireless (Access Point) management for a “unified management” approach.	
4	The solution shall be able to automatically discover new Switch or APs added to the network.	
5	The solution shall be able to blacklist a client, either manually or automatically after a client attack has been detected.	
6	The centralized management function shall allow per equipment configuration and software backup and restore, and bulk backup and restore.	
7	The centralized management function shall allow access to all wIPS/wIDS features.	
8	The centralized management function shall offer, on the basis of an application signature file, insight at application layer (e.g. facebook.com, youtube.com, salesforce.com...) even if the applications run on top of the HTTP or HTTPs protocols. It shall also allow control of those applications.	
9	The solution should allow the admin to easily provision, manage and maintain a network infrastructure with alarms, unified access security policies	
10	The solution should provide full visibility into wireless, devices and applications, as well as predictive analysis for forward planning	
11	The management solution should act as comprehensive tools for infrastructure configuration, monitoring, security, device configuration, alert management, to accelerate, downtime resolution, and overall management.	
12	It should be web based interface with customizable dashboard	
13	Provide details about problematic devices including temperature, memory etc.	
14	Monitor network bandwidth and end device traffic pattern	
15	Provide top applications/users usage analytics real time and historical	
16	Port utilization details and threshold limits	
17	Provides threat mitigation through a secure perimeter against intrusion and malware attacks	

18	Should support third party network devices for basic SNMP and report	
19	Port utilization details and threshold limits	
20	Provides threat mitigation through a secure perimeter against intrusion and malware attacks	
21	Should support third party network devices for basic SNMP and report	

**ix. Specification for Firewall:-**

	<b>Standard Compliance</b>	<b>Compliance (Yes/No)</b>
	<b>Firewall</b>	
1.	The Proposed Firewall Vendor should be in the Leaders' Quadrant of the latest Gartner Magic Quadrant for Enterprise Firewalls	
2.	Firewall appliance should be supplied with at least 4x10GE SFP+, 12x GE RJ45, 4x1GE SFP (SFP Transceivers to be populated as per solution requirement). In addition, it should have dedicated 1GE RJ-45 interfaces for Management and High Availability.	
3.	The Firewall Threat Prevention (FW + AVC + IPS+ Antivirus +Anti Malware) throughput should be at least 2 Gbps for mix / production traffic.	
4.	Firewall should have IPSec VPN throughput of 2.5 Gbps	
5.	Firewall should support 50 K new sessions per second	
6.	Firewall should support 1 Million concurrent sessions	
7.	Firewall should support 1500 site-to-site VPN tunnels & 2000 Client to Site VPN tunnels	
8.	The Firewall solution should support NAT64, DNS64 & DHCPv6	
9.	The Firewall device should have in-built SSD based storage of at least 240 GB.	
10.	The proposed system shall be able to operate on either Transparent (bridge) mode to minimize interruption to existing network infrastructure or NAT/Route mode. Both modes can also be available concurrently using Virtual Contexts. Minimum 8 Virtual Firewall licenses to be provided with the solution.	
11.	The physical interface shall be capable of link aggregation, otherwise known as the IEEE 802.3ad standard, allows the grouping of interfaces into a larger bandwidth 'trunk'. It also allows for high availability (HA) by automatically redirecting traffic from a failed link in a trunk to the remaining links in that trunk.	
12.	The proposed system should have integrated Traffic Shaping functionality.	

13.	The Firewall should have integrated SSL VPN solution to cater to 500 SSL VPN concurrent users.	
14.	The Firewall, IPSEC VPN, Antivirus/anti malware modules shall belong to product family which minimally attain Internet Computer Security Association (ICSA) Certification.	
15.	The proposed system should support	
	a) IPSEC VPN	
	b) PPTP VPN	
	c) L2TP VPN	
	d) SSL VPN	
16.	The device support inbuilt hardware VPN acceleration	
17.	NGFW solution should have capability to protect against Denial of Service (DOS) and DDOS attacks. Should have flexibility to configure threshold values for each of the Anomaly. DOS and DDOS protection should be applied and attacks stopped before firewall policy look-ups.	
18.	NGFW should have a configurable actions like terminate a TCP session by issuing TCP Reset packets to each end of the connection, or silently drop traffic in addition to sending a alert and logging the incident	
19.	Firewall should have capability to monitor ISP link quality in terms of latency, jitter & packet loss.	
20.	Firewall should have capability of intelligent routing based on layer 7 application visibility, automatic failover and failback of traffic on ISP links based on link Performance SLAs.	
	<b>Virtualization</b>	
21.	The proposed solution should support Virtualization (Virtual Firewall, Security zones and VLAN).	
	<b>Intrusion Prevention System</b>	
22.	The IPS capability shall minimally attain NSS Certification	
23.	The firewall should have inbuilt management or else separate dedicated management appliance from same OEM should be provided with solution.	
24.	The IPS detection methodologies shall consist of:	
	a) Signature based detection using real time updated database	
	b) Anomaly based detection that is based on thresholds	
	The IPS system shall have at least 10,000 + signatures	

25.	IPS Signatures can be updated in three different ways: manually, via pull technology or push technology. Administrator can schedule to check for new updates or if the device has a public IP address, updates can be pushed to the device each time an update is available	
26.	In event if IPS should cease to function, it will fail open by default and is configurable. This means that crucial network traffic will not be blocked and the Firewall will continue to operate while the problem is resolved	
27.	IPS solution should have capability to protect against Denial of Service (DOS) and DDOS attacks. Should have flexibility to configure threshold values for each of the Anomaly. DOS and DDOS protection should be applied and attacks stopped before firewall policy look-ups.	
28.	IPS signatures should have a configurable action like terminate a TCP session by issuing TCP Reset packets to each end of the connection, or silently drop traffic in addition to sending a alert and logging the incident	
29.	Signatures should a severity level defined to it so that it helps the administrator to understand and decide which signatures to enable for what traffic (e.g. for severity level: high medium low)	
	<b>Antivirus</b>	
30.	The threat prevention (FW + AVC + IPS + Antivirus /Antimalware) throughput should be at least 2 Gbps on Mix / Production traffic	
31.	The NGFW solution must have capability to integrate with Anti-APT solution to scan for zero day malwares from Day 1	
32.	The proposed system should be able to block, allow or monitor only using AV signatures and file blocking based on per firewall policy based or based on firewall authenticated user groups with configurable selection of the following services:	
	a) HTTP, HTTPS	
	b) SMTP, SMTPS	
	c) POP3, POP3S	
	d) IMAP, IMAPS	
	e) FTP, FTPS	
33.	The proposed system should be able to block or allow oversize file based on configurable thresholds for each protocol types and per firewall policy.	
	<b>Web Content Filtering</b>	
34.	The proposed Firewall device should provide Web filtering and Video Filtering inspection. Web filtering should be based on real-time URL categorization	



	database of at least 250+ million URLs with 75+ categories.	
35.	Firewall should have Safe Search capability to transparently inserts Safe Search parameter in request for at least Google, Bing, Yahoo etc . It should support YouTube Education Filter.	
36.	Web filtering should support local categories & category rating override to customize the filters.	
37.	The proposed system shall have the ability to detect, log and take action against network traffic based on over 3000 application signatures	
38.	The application signatures shall be manual or automatically updated	
39.	The administrator shall be able to define application control list based on selectable application group and/or list and its corresponding actions	
	<b>Application Control</b>	
40.	The proposed system shall have the ability to detect, log and take action against network traffic based on over 3000 application signatures	
	The application signatures shall be manual or automatically updated	
41.	The administrator shall be able to define application control list based on selectable application group and/or list and its corresponding actions	
42.	<b>High Availability</b>	
43.	The proposed system shall have built-in high availability (HA) features without extra cost/license or hardware component	
44.	The device shall support stateful session maintenance in the event of a Fail-over to a standby unit.	
45.	High Availability Configurations should support Active/Active or Active/Passive	
46.	The Firewall device should have internal redundant hot swappable power supplies.	
47.	<b>Logs and Report</b>	
48.	The Logs and Reporting platform must be a dedicated same OEM appliance and VM/software running on server will not be accepted.	
49.	The Logs and Reporting platform support running on-demand and scheduled reports	

50.	Should have 4 TB of Hard Drive Capacity for logging and reporting if not please quote separate appliance	
51	Real-time display of information allows you to follow real-time trends in network usage such as the source IP address and the destination URL for HTTP traffic or IM message traffic.	
52	All log files and messages are searchable and can be filtered to drill down and locate specific information.	

## 7. **IPPBX System**

### **IPPBX Technical Specifications**

<b>Sl. No</b>	<b>Technical Qualitative Requirements/ Specifications</b>		<b>Compliance (Y/N)</b>
<b>1</b>	System Architecture	The telephony system should be designed with IP at the core Server & Gateway type communications system, allowing fully distributed IP solutions across data networks. The system will be call servers based and it should support traditional TDM or mixed IP-TDM or full 100% IP configurations, telephony, gateway , end points & all telephony application should be from same OEM& PRI card should not be installed in any PC/ Server	
		It should support the following devices :-	
		(i) <b><u>IP Communication Devices</u></b> e.g. IP Phones, Video Phones, Multimedia PCs, SIP phones, Softphones or H.323 terminal devices etc.	
		(ii) <b><u>Legacy TDM communication devices</u></b> (Digital and analog 2 Wire telephone instruments with Caller-ID	
		The <b><u>call control servers should be fully redundant solution</u></b> The solution must provide geographical redundancy by separating the servers over LAN/WAN. i.e .if the server in the main data center fails, the other server, which is installed at geographically different location over LAN/WAN should take over the entire communication network load.	
		The proposed system should support both industry standard OEM servers (HP, Dell, Lenovo) and Proprietary hardware as Call control server	
		The system should be capable of supporting analog and IP Telephones. System should support up to 5000 users on the same hardware that is supplied as part of this RFP.	
		The system should manage CAC (Call Admission Control) mechanisms to optimize the usage of the bandwidth in the WAN for multi-site configurations.	
		The system should be capable of supporting a very high traffic and should support a Busy Hour Completion (BHCC) of 3, 00,000 per hour and/or Busy Hour Call Attempt (BHCA) of	

		10,00,000 per hour	
		The IPPBX should be day one ready with full telephony Feature/ Functionality; all necessary hardware should be provisioned from day one for this. Full SIP (able to connect 3rd Party SIP Phone & SIP Trunk Public & Private) capability. The main functions of SIP capability should provide SIP networking (Public & private ) and	
		Support SIP endpoints in a converged communications network.	
		All the users to be managed in a single database,	
		Which is managed centrally, no multiple databases & bundling of Telephony system will not consider to meet Specification & scalability.	
		The voice network architecture and call control	
		Functionality should support both SIP / H.323.	
		The system should be based on server gateway	
		Architecture with external server running on Linux OS.	
		The system should be able to operate with H.323/SIP compliant device and it should be able to support internal gatekeeper for the same.	
		The SIP proxy, SIP registrar should be inbuilt in the system and should support open SIP stack compliant hard phones or soft phones also.	
		IPv4 & IPv6 support from day one & The quoted model should be TEC approved. Vendor to submit TEC approval certificate along with the bid	
		The system should have non-blocking architecture at all levels & must support more than 80 time slots per gateway	
		The system should support for voice encoding using following standards:-	
		(i) G.711	
		(ii) G.729A	
		(iii) G.722	
		<b><u>Call Switching.</u></b> Internal calls : Based on the G.711 uncompressed PCM standard.	
		The System should support Network Time Protocol V4.1.2 (RFC 1305) to synchronize the system date/time of network devices.	
		The system should be suitable to accommodate both Decadic Pulse (DP) and DTMF telephones. The system should support outgoing DTMF transmission even from Digital phones.	
		The system should have <b><u>non blocking architecture at all levels</u></b> like System processing, Switching fabric, power supplies, other resources like DTMF receivers, R2 Receivers, unlimited 3 or more party conference circuits.	
		<b><u>VoIP Support.</u></b> System should support VoIP solutions as an integral part of the system.	
		(i) The system should be fully compliant to VoIP standards like	

		H.323 / SIP (Session Initiation Protocol). Vendor to give clear compliance for the requested standards.	
		(ii) The system should be able to operate with any H.323/SIP compliant device and it should be able to support internal gatekeeper for the same. If required, it should be able to inter operate with H.323/SIP standard based external gatekeepers.	
		(iii) The SIP proxy, SIP registrar should be inbuilt in the system and should support any open SIP stack compliant hard phones or soft phones.	
		(iv) System should support the QOS features for the VOIP implementation. It should be compliant with both QOS standards (Layer 2 – 802.1 p/q) and Layer 3- Diffserv/TOS).	
		(v) VOIP Gateway should have minimum 250 Channels and should provide :-	
		Trunk switching link over IP	
		Access to IP phones.	
		Access to multimedia PC.	
		Voice over IP logical links and trunk groups.	
		Perform voice compression/decompression and IP packets.	
		<b>IPv4/IP v6.</b> IPv4/IPv6 support from day one & The quoted model should be TEC approved. Vendor to submit TEC approval certificate along with the bid	
		The proposed system should Support Automatic Route Selection (ARS) and Least Cost Routing (LCR) features to route the calls based on priorities related to user profile and network availability, along the most cost- effective path. This service should be transparent for users and irrespective of the physical carrier connection.	
		Should provide/support a cloud-based, enterprise-grade, Communication Platform thus delivering a collaborative business application extending features viz. Instant Messaging/Telephony Presence, click to call (dial by name, answer, release), Call Log, P2P Audio/Screen Sharing	
		The system must support an IP Softphone application that allows the users to manage their calls from a PC or MAC/ iPhone/ iPad/ Android . This user must have access to the full set of telephony services without any degradation. The voice should be managed by the multimedia resources of the PC.	
		Offered solution must support at least 50 remote media gateways	
<b>2</b>	<b>System Security</b>		
		The System must support Syslog services for both internal and external command and configuration control accounting with a	

		minimum of 30 day history.	
		The Call Server must be provided adequate protection from possible virus, worm and Trojan infestation	
		The Call Server must be provided adequate protection from possible virus, worm and Trojan infestation points such as internal e-mail servers and they must be updated every month. In case customized hardened linux distributions are being provided this clause will not be applicable.	
		The password and access control must include at least:-	
		(i) Management console access to be provided by dual role based authentication (one of user rep and one of administrator rep).	
		(ii) Management console access must allow only access to level of viewing of running configuration and status of current configurations and syslogs	
		(iii) For any configuration changes again a dual role based authentication system for write access fully integrated with the management console application for carrying out the authorized configuration changes must be provided. The system should be capable of integrating with existing system installed at DFCCIL (WDFC, EDFC, Head Office and any other location as required) in SIP trunking.	
		(iv) Logs of all activities to include configuration change, housekeeping activities and any other action on the system and specifying the time of activity must be available for each day.	
		(v) Account access authentication/ restriction using external RADIUS/ LDAP/ AD resources.	
		Media Gateways should not host services such as proxy, FTP or local dynamic routing except those required for software Up-gradation /backup etc. to prevent exploitation in Distributed Denial of Service attacks.	
		IP Phones should not support direct, external initiated, connections via HTTP, telnet, FTP, TFTP or any other protocol as means to prevent distributed Denial of Service attack exploitation, except those required for software Up gradation/backup etc.	
		IP Phone must support 802.1x (EAP-MD5 or better) for authentication and access control to the network, this mechanism must allow the user to be connected to the call server once he has passed the authentication process, not before.	
		The system should have the capability to, based on standard mechanism (such as 802.1Q and DHCP), assign automatically the corresponding voice VLAN number to the IP station clients during IP station initialization, allowing for the separation of voice and Data traffic at IP station.	
		Commercial grade optional encryption security with minimum	

		128 bit key security for both signaling and voice with in a node for all IP subscribers – IP subscriber communications.	
		Commercial grade optional secrecy with minimum 128 bit key encryption security for both signal ingand voice for inter-node communication between same type of exchs over IP trunks in which all traffic between analog/digital/IP over the IP trunk must been crypted for both signaling and data.	
		System should use randomly generated keys derived from base keys for every voice and signaling session Established by the system.	
<b>3.</b>	<b>System Management</b>		
		The system should provide a dedicated management server/platform that will be based on the latest technologies. This server should support a minimum of five or more clients having different access rights to the applications.	
		The management platform should provide to provide a single graphical client (Graphical User Interface (GUI)) as well as a web based interface for all network elements used in the IP PBX network.	
		The Management platform should provide web access allowing the administrator to manage the system to use any PC with an internet browser.	
		The management platform should provide the following tasks, as per the ask :-	
		(i) <b><u>Configuration and programming</u></b>	
		(aa)Services, users, categories and all system Parameters and features.	
		(ab)Provide centralized management in local orremote environments of a single system or a network.	
		(ac)The network manager will be able to quickly and easily edit, create or delete any subscriber profile/network object by the use of import/export functions and multiple operations.	
		(ii) <b><u>Faults and Alarms management</u></b>	
		(aa) All the incidents and fail reports generated by the System itself informing date, hour and severity.	
		(ab) This module must be able to centralize the alarms and Events of the System and give colors according to the severity level of the alarm.	
		(ac) Notify an alarm depending on the severity level sending an e-mail or activating a script performing a specific action.	
		(ad)Register and generate statistics for the alarms and events in the network on a daily basis.	
		(iii) <b><u>Fault diagnosis</u></b> Generate reports about the statistics of the alarms.	
		(iv) <b><u>Accounting</u></b> of all external calls generated by the users	

		including cost, date, hour. Must provide different options to group the monitoring of the calls (cost center, extension number, trunk, user, city/area associated to dialed numbers). IP PBX system should have buffer of last 2500 tickets of call details in case of Call billing system/ management system failing	
		(v) <b><u>Directory module</u></b> should support to manage the telephone directory. This must be LDAP compatible and the exchange directory should be available on web. The LDAP server and web server application should be integral to the exchange synchronized with other directory applications, must also allow web access and provide information on all desktops allowing click to call features to the users.	
		(vi) <b><u>Web Interface to Directory</u></b> Should support exchange directory available on web. The LDAP server and web server application should be integral to the exchange. This feature should be available for all type of users extensions.	
		(vii) <b><u>Integrated Directory</u></b> . It shall be possible to provide display equipped voice terminals with access to system directory on digital and IP phones. Also System should support internal and external LDAP directory. Any internal user can use it by browsing the URL link from his laptop/ PC to see the directory and Dial the required no by select in gunder LDA Pdirectory.	
		(viii) <b><u>Call Metering and Accounting</u></b> The log of local to local call should be supported. The logo flocal to trunk call in both directions (incoming as well as outgoing) should be maintained in the exchange in the hard disk. Should support Malicious Call Trace.	
		(ix) <b><u>Performance of Trunk operators</u></b> The system should support to report clearance of calls by operators and evaluate performance index of each operator.	
		(x) <b><u>Reports</u></b> The management platform must allow the administrator to generate reports of the activity per period of time in terms of traffic, accounting and alarms and giving the possibility to generate statistic of all this analysis. Those reports must be predefined but the option to personalize the reports must be also available. These reports should be exportable in HTML, pdf, excel and LDAP (.ldif) formats.	
		(xi) <b><u>MonitoringModule</u></b> which allows the administrator to easily monitor the accounting thresholds of the users of cost centers in graphical interface and must allow to send an e-mail or an alarm in case of threshold crossing.	
		<b><u>Network Topology</u></b> . The management server should support an application that offers a topological view of the all network elements in graphical form such as main, remote unit and connectivity.	

4	Security		
		(i) Administration users connection directly to the call server (Console) must be authenticated via server Before gaining access to the call server.	
		(ii)All management traffic between a remote console/session and the call server must be secured. (SSH for direct command line session, HTTPS (SSL) for web sessions, SFTP for file transfer, etc.)	
		(iii)The management platform must provide Role based account management to define the different Levels of administrator access depending on specific function responsibility.	
5	System Survivability	-	
		The system should offer maximum availability, with the switchover of call control processing functions to an alternate or redundant processor in the event of significant fault. The redundancy scheme should conform to the model used in most computer systems: the complete "mirroring" of the information (both static and dynamic data.) The switch over between 2 call servers in LAN or WAN location over L2 or L3 Network <b><u>should not interrupt existing and established communications</u></b> to include all analog, digital, hard, soft and Video IP Phones. The complete set of programs and software modules must be duplicated in real time. In case of failure of the main Server (hardware or software), the standby Server (emergency mirror) must take over the control of communications instantaneously.	
		All critical resource elements (call server, hard disks, data bases, IP interfaces, DSP resources, clocking sources, Processor, RAM, Tone generators, All the IO ports – serial and Ethernet TCP/IP ports, Ring generators, resources like DTMF receivers, Tone detectors etc.) must be <b><u>redundant and in a hot- standby configuration</u></b>	
		Remote Media Gateway should support <b><u>survival mechanism that allows them to maintain 100% of the telephony services</u></b> for their users, in case of failure in the WAN links where the signaling with the call server drops.	
		The management platform must provide a <b><u>backup mechanism</u></b> for all critical system information in a both annual and an automatic/ schedule archival and a Disaster Recovery Mechanism.	
		<b><u>Replacement of cards</u></b> without switching off exchange (hot swappable) including the peripheral/interface cards.	
		All the tone generation and tone detection should be local to the gateway.	
		The system should be able to restart automatically without human intervention when the external ac power supply is resumed after complete power failure i.e Even after batteries are discharged.	



		The call server should support the two or more different Geographically locations more than 10 Kms in the network.	
		<b>Life Cycle</b> of entire exchange system being provided should be minimum Five years, 1 year warranty & 5 year AMC support	
		Call Server Should support expansion up to 5000 Subscriber ports.	
		Main Location Should have minimum 5 universal slots in single cabinet/chassis.	
		System shall have backup batteries powering it for 4 Hrs.	
<b>6</b>	Environment al Conditions	-	
		The equipment offered shall be capable of maintain its guaranteed performance when operating continuously for 24 hours a day and 365 days a year under the following environmental conditions:-	
		Operating temperature : 0 to 45 degree C.	
		Storage 0 degree C to +45 degree C.	
		Humidity 10% to 95% without condensation	
		The exchange cabinet should have fans (integrated with system) for cooling the system rack/cabinet.	
		Calling line identification restriction for internal calls Camp on busy telephone/hunting group/voice mail, Controlled private call by Pin code and password.	
		Do not disturb, Dynamic call baring General night service Hunting group (fix head cyclic, longest idle time, parallel)	
		Internal/external music on hold internal/external inquiry call individual hold instrument locking to prevent the outgoing.	
		Minimum 28 Party Meet-me Conferencing, minimum 28 Party Blast Dial Conferencing	
		Last internal/external number redial, Personal code modification, Priority call, Priority cut in, Store and redial external number, Transfer in conversation on free/busy telephone.	
		CLI coming in from ISDN PRI trunks should be displayed on Analog Telephones, Digital Telephones and IP Telephones.	
		<b>External Holding Tone</b> :The system shall support in-built music-on-hold. It shall also be able to interlace with an external music device( like PC or CD Player)	
		When all attended consoles are engaged, the external caller shall be informed of this situation by voice message. The call should be routed to the least loaded operator.	
<b>7</b>	System Network	-	

	Support		
		Should Support Q SIG standards over IP/ TDM/ WAN trunks.	
		Heterogeneous, open numbering plan.	
		Calling/Connected Line Identification Presentation and Restriction.	
		Calling/Connected Name Identification Presentation and Restriction.	
		Call Forwarding Unconditional, Busy, No Reply ,Call Transfer.	
		Call Completion to Busy Subscriber, on No Reply, call Offer.	
		The system should have options to network over any of MPLS, IP, ISDN	
		The system must support the following external telephony interface signaling:-	
		E1 CCS PRI	
		E1 CAS (R2 MFC )	
		ISDN PRI (ETSI)	
		Analog Loop Start and Ground Start	
8	Voice Mail Features	-	
		<b>General.</b> The system should support a software based voice mail of the same OEM or 3 <sup>rd</sup> part, offering the best interactivity with user. The voice mail must work as a centralized resource in case remotes are connected to the main exchange.	
		The Voice Mail supported by the vendor should be based on industry standard server or could be based on OEM server hardware.	
9	Analog Subscriber card.		
		Should support 16 or more ports	
		Each port should support CLIP features (FSK or DTMF)	
10	Digital Subscriber card.		
		Should support 8 or More ports.	
		Each port should support CLIP features (FSK or DTMF).	
		Provide digital ports for connecting digital telephones, attended consoles etc.	
11	IP Phone		

	Type - I		
		IP terminal with Tilttable Color Display min 4.3 inch; 480 x 272dot should have the following minimum technical specifications:	
		XML support	
		Dual ports, 10/100/1000base-TX, Full Duplex, Auto Negotiation/Fixed LAN interface	
		Voice Codec G.711, G.729a/G.722	
		IP address setting direct or via DHCP server	
		Qos: ToS (IP Precedence, Diffserv)	
		VLAN Tagged IEEE802.1Q/p	
		Security IEEE802.1x authentication (EAP-MD5/ EAP-TLS, EAPOL Forwarding), RTP encryption, Autoconfig encryption	
		PoE Class 2	
		Two step adjustable base	
		4 line X 24 digit display	
		Backlit Display and Dial Pad	
		24 Programmable keys with Dual Colour LED support	
		8 Fixed feature keys, 4 Navigator Keys and 60 Key DSS support	
		4 Soft keys, RJ9 Headset Port	
		Full Duplex Hands free mode, Wideband Codec	
		Caller Name, Number and Image support	
		Screen saver and Screen Lock	
		Wide Size Incoming Lamp with 7 color support	
		ROHS Compliant	
		Phone should be from same EPABX OEM.	
<b>12</b>	Digital Phone	3.5 Inch Tilttable Backlit LCD display	
		4 lines x 24 characters per line LCD display with adjustable angle	
		Separate Visual Message Wait Indicator Lamp with multicolor option	
		Minimum 24 flexible programmable keys & 4 soft keys support	
		Dual color LED indication, Backlit Dial Pad	
		Navigational Keys	
		Incoming Speech Gain Control	
		Ringer Volume Control	
		Supports Analog port adaptor for ringer and modem functionality	
		Full Two Way Duplex speaker phone, RJ9 Headset Port	
		Wide Size Incoming Lamp with 7 color support	

		Adjustable Handset and Monitor speaker volume	
		Monitor Speaker / On-Hook dialing	
		Call disconnection through cradle switch no magnetic switch will acceptable.	
		Expandable by additional Button Modules	
		Must have provision for smart phone collaboration via blue tooth adopter	
		Must support 8 Key DSS with Dual color LED and must not consume any additional digital port.	
		ROHS Compliant	
<b>13</b>	Operator Console (IP Phone)	IP based operator console having total 84 programmable keys, 4.3 Inch Colour Tilttable Display; 480 x 272dot and below specifications	
		XML support	
		Dual 10/100/1000base-TX Port, Full Duplex, Auto Negotiation/Fixed LAN interface	
		Voice Codec G.711, G.729a/G.722	
		IP address setting direct or via DHCP server	
		Qos: ToS (IP Precedence, Diffserv)	
		VLAN Tagged IEEE802.1Q/p	
		Security IEEE802.1x authentication (EAP-MD5/ EAP-TLS, EAPOL Forwarding), RTP encryption, Autoconfig encryption	
		PoE Class 2	
		Two step adjustable base	
		4 line X 24 digit display	
		Backlit Display and Backlit Dial Pad	
		24 Programmable keys with Dual Colour LED support and add-on 60 Prog Keys DSS module	
		8 Fixed feature keys, 4 Navigator Keys	
		4 Soft keys, RJ9 Headset Port	
		Full Duplex Hands free mode, Wideband Codec	
		Caller Name, Number and Image support	
		Screen saver and Screen Lock	
		Wide Size Incoming Lamp with 7 color support	
		ROHS Compliant	

## 8. AUDIO AND VIDEO SYSTEM

### Technical Specifications

Category	Description
<b>Audio Visual Management System</b>	8x1 4KDCI 4:4:4 Multiformat presentation switcher and control system (either built-in or additional hardware) from the same OEM. It should have 4 x HDMI input, 4XVGA + 4XAUD IN and 1 x HDMI Scaled out. It should have Audio Embedder & De-embedder

	with 1 x Audio out to be fed to Audio system. It should have (inbuilt or additional) control system having 1 GB RAM, 4GB Storage, 1 RS232 Ports, 1 IR Ports. It should be able to execute multiple programs and control AV equipment, accessoires, Lighting, HVAC etc from Touchscreens and keypads. It should also offer BACnet/IP for interfacing with BMS. It should have ethernet control for all the slave AV devices.
	<p>AV over IP Encoders-Full HD over IP Extension, Supports point-to-point, point-to-multipoint and multipoint-to-multipoint configurations , Up to 120m over a single Cat.5e/6 cable in point-to-point connection, with 1x looping HDMI output for daisy chaining, TCP/IP protocol compliant with selectable streaming bit rate up to 15Mbps per stream, H.264 compression encoding that support resolution up to 1080p@60hz, HDCP Compliant, IR Remote control, with LED display to show the Group ID. Fully operating just out of the box without the need of PC connection ,Integrated web server for configuration, PC tool control and Telnet control (EclerNet Manager and third party remote control compatible, Supports LPCM audio format , Wide-band IR pass through to control the source (38kHz to 56kHz), 2 way UART/RS-232 (Up to 115200) pass-through, with remote control function to select 8 group Baud rate options , Dual power input: 802.3af compliant POE &amp; DC 5V (No need of external power supply when encoders and decoders are connected to a POE Switch Inputs : 1x HDMI, 1x RS-232, 1x IR , Outputs : 1x HDMI, 1x H.264 Streaming, 1x RS-232, 1x IR , Resolution 1080p@24/25/29.97/30/50/59.94/60Hz, 1080i@50Hz, 720p@50/59.94/60Hz, 576p, 576i@50Hz, 480p, 480i@59.94/60Hz   Vesa 640×480,800×600,1024×768,1280×768, 1280×960,1280×1024,1680×1050, 1920×1080,1280×720,1360×768,1400×1050 , Features : Downscaling, HDCP Support, RS-232/IR Extension, PoE, Control Options :Web, Telnet, IR</p> <ul style="list-style-type: none"> <li>HDMI + CONTROL Extender Pair from the same OEM. TX should have 1 x HDMI IN and 1 x Twisted pair OUT. RX should have 1 x Twisted Pair IN and 1 x HDMI OUT. Should support Resolution of up to 4K DCI 4:4:4 and Distance at least 70m using same OEM Cable. Same pair should extend IR and RS232 using dedicated input and output port at TX and RX .+ 8 channel power switch, supports 240 volt 50/60 Hz lighting and Motor loads for Shades / Projection screens / Lifts and Lighting control from the same OEM as Control systems.</li> </ul>
	<ul style="list-style-type: none"> <li>Low susceptibility to interference from mobilephones.</li> </ul> <p>The microphone shall have the following controls and indicators:</p> <ul style="list-style-type: none"> <li>Red or green illuminator. Red shall indicate that the microphone is active; green shall indicate that the request-to-speak is accepted. Frequency Bandwidth 100 Hz – 15 kHz according IEC60914</li> </ul> <p>Dynamic range &gt; 96 dB</p>
<b>Control Processor</b>	<p>Control Processor- SD RAM 512 MB, Flash 4 GB, 10/100 Mbps, auto-switching, auto-negotiating, auto-discovery, full/half duplex, industry-standard TCP/IP stack, UDP/IP, CIP, DHCP, SSL, TLS, SSH, SFTP (SSH File Transfer Protocol), FIPS 140-2 compliant encryption, IEEE 802.1X, SNMP, BACnet/IP [1], IPv4 or IPv6, Active Directory authentication, IIS v.6.0 Web Server, SMTP e-mail client</p> <p>Supports USB mass storage class devices via rear panel USB 2.0 host ports, supports computer console via front panel USB 2.0 device port</p> <p>RS-232/422/485 For 2-way device control and monitoring, all ports support RS-232 up to 115.2k baud with software handshaking, one port also supports RS-422 or RS-485 and hardware handshaking</p>

	IR/Serial Supports 1-way device control via infrared up to 1.2 MHz or serial TTL/RS-232 (0-5 Volts) up to 115.2k baud, RELAY OUTPUT 1 – 8, I/O 1 – 8, IR - SERIAL OUTPUT 1 – 8
	5 Inch Touch panel with Table mount kit and POE power supply. It should be from the same OEM and should support custom graphics programming. It should have auto-brightness control, in-built microphone, speakers and camera. Should support SIP intercom feature, streaming H.264 videos, web browsing, multitouch. Resolution - 960x540, Brightness - 400 nits or higher. 2 GB RAM and 4GB storage.
<p>Delegate Unit-The discussion device shall have the following features and benefits:</p> <ul style="list-style-type: none"> <li>- Supports star and loop-troughconnection.</li> <li>- Dual-use functionality enabled by use of software.</li> <li>- Audio mutebutton</li> <li>- Encryption ensures that information within the systemremains confidential</li> </ul> <p>The device shall have a headphone connection and independent volume control (on both sides of the device), so the speaker can be heard clearly even when there is excessive background noise Frequency response 100 Hz – 20 kHz (-3 dB at nominal level) THD at nominal level &lt; 0.1% Dynamicrange &gt; 90 dB Signal-to-noiseratio &gt; 90dB Operating temperature 5 °C to +45 °C The ‘pluggable high-directive microphone’ shall be a stylish high-directive microphone that shall give the user a clear view of the meeting room, due to its unobtrusive design. The high-directive microphone shall contain two precisely positioned capsules to give it a high-directive response. This shall make it possible to have a larger speaking distance than normal from the microphone, even in noisy conditions. The microphone shall have the following features and benefits:</p> <ul style="list-style-type: none"> <li>• Discrete microphone for userconvenience.</li> <li>• High-directive response.</li> <li>• Ultra-low noise.</li> <li>• Low susceptibility to interference from mobilephones.</li> </ul> <p>The microphone shall have the following controls and indicators:</p> <ul style="list-style-type: none"> <li>• Red or green illuminator. Red shall indicate that the microphone is active; green shall indicate that the request-to-speak is accepted. Frequency Bandwidth 100 Hz – 15 kHz according IEC60914 Dynamic range &gt; 96 dB</li> </ul>	
License-Server Software, Participant Database , Identification at seat License for above conferencing system	
Powering Switch- Additional power switching device for Chairman Unit and Delegate Units	
<p><b>AV over IP Decoders</b>-Supply of full HD over IP Extension, Supports point-to- point, point-to-multipoint and multipoint-to-multipoint configurations, Up to 120m over a single Cat.5e/6 cable in point-to-point connection, with 1x looping HDMI output for daisy chaining, TCP/IP protocol compliant with selectable streaming bit rate up to 15Mbps per stream, H.264 compression encoding that support resolution up to 1080p@60Hz, HDCP Compliant, IR Remote control, with LED display to show the Group ID. Fully operating just out of the box without the need of PC connection, Integrated web server for configuration, PC tool control and Telnet control remote control, compatible), Supports LPCM audio format, Wide-band IR pass through to control the source (38kHz to 56kHz), 2 way UART/RS-232 (Up to 115200) pass-through, with remote control function to select 8 group Baud rate options, Dual power input: 802.3af compliant POE &amp; DC 5V (No need of external power supply when encoders and decoders are connected to a POE Switch). Inputs 1x H.264 Streaming, 1x RS-232, 2x IR , Outputs 1x HDMI, 1x RS-232, 1x IR , Features : Downscaling, HDCP Support, PoE, Control Options Web, Telnet, IR.</p>	

<b>AV over IP Encoder</b>	<p>AV over IP Encoders-Full HD over IP Extension, Supports point-to-point, point-to-multipoint and multipoint-to-multipoint configurations, Up to 120m over a single Cat.5e/6 cable in point-to-point connection, with 1x looping HDMI output for daisy chaining, TCP/IP protocol compliant with selectable streaming bit rate up to 15Mbps per stream, H.264 compression encoding that support resolution up to 1080p@60hz, HDCP Compliant, IR Remote control, with LED display to show the Group ID. Fully operating just out of the box without the need of PC connection, Integrated web server for configuration, PC tool control and Telnet control (, Supports LPCM audio format ,Wide-band IR pass through to control the source (38kHz to 56kHz), 2 way UART/RS-232 (Up to 115200) pass-through, with remote control function to select 8 group Baud rate options , Dual power input: 802.3af compliant POE &amp; DC 5V (No need of external power supply when encoders and decoders are connected to a POE Switch</p> <p>Inputs : 1x HDMI, 1x RS-232, 1x IR , Outputs : 1x HDMI, 1x H.264 Streaming, 1x RS-232, 1x IR , Resolution 1080p@24/25/29.97/30/50/59.94/60Hz, 1080i@50Hz, 720p@50/59.94/60Hz, 576p, 576i@50Hz, 480p, 480i@59.94/60Hz   Vesa 640×480,800×600,1024×768,1280×768, 1280×960,1280×1024,1680×1050, 1920×1080,1280×720,1360×768,1400×1050 , Features : Downscaling, HDCP Support, RS-232/IR Extension, PoE, Control Options :Web, Telnet, IR</p>
<b>Ceiling Mounted Document Camera</b>	<p>Ceiling Mounted Document Camera- Supply of Full HD 1080p high definition output resolution One button optimization function, Intelligent time stamp on saved les, High-definition USB image transmission in real time, Plug &amp; Play, no need to install USB driver, Customized video splash screen, Projector type (DLP/LCD) select mode, Free multi-functional cross platform software support, Compatible with all major IWB brands.</p>
<b>Conferencing Sound Bar with Camera</b>	<p>VC-Conferencing Sound Bar with Camera</p> <ul style="list-style-type: none"> <li>• Inbuilt Wide View Full HD, 1/2.7" CMOS camera minimum 110degree</li> <li>• Inbuilt Microphone array with echocancellation</li> <li>• HDMI, Bluetooth and USB connectivity supportBYOD.</li> <li>• Remote control for Volume control, disconnect, source select, MicMute etc.</li> <li>• WallMountable</li> <li>• USB connectivity with Laptop / Wireless collaboration device (Skype for Business) / Interactive display / any other device to use Camera, Microphone andSpeaker.</li> </ul>

<b>Control Processor</b>	<p>Control Processor- Supply of SD RAM 512 MB, Flash 4 GB, 10/100 Mbps, auto-switching, auto-negotiating, auto-discovery, full/half duplex, industry-standard TCP/IP stack, UDP/IP, CIP, DHCP, SSL, TLS, SSH, SFTP (SSH File Transfer Protocol), FIPS 140-2 compliant encryption, IEEE 802.1X, SNMP, BACnet/IP [1], IPv4 or IPv6, Active Directory authentication, IIS v.6.0 Web Server, SMTP e-mail client</p> <p>Supports USB mass storage class devices via rear panel USB 2.0 host ports, supports computer console via front panel USB 2.0 device port</p> <p>RS-232/422/485 For 2-way device control and monitoring, all ports support RS-232 up to 115.2k baud with software handshaking, one port also supports RS-422 or RS-485 and hardwarehandshaking</p> <p>IR/Serial Supports 1-way device control via infrared up to 1.2 MHz or serial TTL/RS-232 (0-5 Volts) up to 115.2k baud, RELAY OUTPUT 1 – 8,I/O 1 – 8,IR - SERIAL OUTPUT 1 – 8</p>
<b>HDMI Switcher</b>	<p>HMDI Switcher 2x1-Supply Of HDMI 2.0 4x1 18 Gbps SWITCHER with audio de-embedder ,4x1 Ultra High Definition sources selector compliant with HDMI 2.0a standards , Video formats up to 4Kx2K(4096x2160@60Hz YUV 4:4:4) and all HDMI 3D video formats and all HDMI , Supports HDR and 3D contents , HDCP2.2/1.4 Compliant , Supports 36 bit Deep Color , Smart EDID management (Auto/2CH/5.1CH/7.1CH selectable), PCM, Dolby TrueHD, DTS-HD Master Audio up to 7.1CH, Supports Audio Return Channel (ARC), Digital and analog audio output, RS-232 Control, Supports up to 18Gbps video data rate.</p> <p>Inputs 4xHDMI , Outputs 1xHDMI , Resolution Up to 4096x2160@60Hz 4096x2160@24/25/30/50/60Hz, 3840x2160@24/25/30/50/60Hz, 2048x1080p 1080p@23.98/24/25/29.97/30/50/59.94/60Hz, 1080i@50/59.94/60Hz, 720p@50/59.94/60Hz, 576p, 576i, 480p, 480i , Features : EDID Management, HDR, HDCP, CEC, ARC , Control Options RS- 232, IR</p>
<b>Microphones</b>	<p>Wired Handheld Microphone</p> <p>Wireless Handheld Mic along with stand -Supply of Handheld Wireless Mic with Cardiod polar pattern for transmitter, Dynamic microphone with Neodymium magnet , Receiver frequency response 80Hz-18kHz,Receiver RF sensitivity &lt; 1.0 <math>\mu</math>V, Receiver Image rejection&gt;55dB,Receiver Dyanmic range &gt;95dB and receiver having 32 channels possible, Receiver S/N ratio &gt;100dB A, distortion &lt;1 % , Transmitter sensitivity - 3.2 mV/Pa, modulation:+/-40kHz</p> <p>Wireless Handheld Mic-Supply of Handheld Wireless Mic with Cardiod polar pattern for transmitt, Dynamic microphone with Neodymium magnet , Receiver frequency response 80Hz-18kHz,Receiver RF sensitivity &lt; 1.0 <math>\mu</math>V, Receiver Image rejection&gt;55dB,Receiver Dyanmic range &gt;95dB and receiver having 32 channels possible, Receiver S/N ratio &gt;100dB A, distortion &lt;1 % , Transmitter sensitivity - 3.2 mV/Pa, modulation:+/-40kHz</p>



	Wireless Lapel Mic-Supply of Wireless Lapel Mic with Cardioid polar pattern for transmitter, Receiver & Transmitter frequency response 100Hz-18kHz or better, Receiver RF sensitivity < 1.0 $\mu$ Receiver Image rejection>55dB,Receiver Dynamic range >95dB and receiver having 32 channels possible, Receiver S/N ratio >100dB A, distortion <1 %,Transmitter sensitivity - 5.6 mV/Pa, modulation:±40kHz.
<b>Touch Panel</b>	Enterprise level Touch Panel with Dock featuring streaming H.264 video, Web browsing. Security Features such as 802.1x, TLS,FIPS-140-2, SSH & SFTP, Ambient Light Sensor, Backlit capacitive Buttons
<b>VC</b>	Table Top UC 7" Video Conferencing System with 16 MP camera; AEC; Full range Speaker;360 degree quad mic array microphone; Occupancy sensor; Real time scaling, F/2.8; 720P @ 30FPS, 3D noise reduction,120 degree horizontal & 90 degree vertical FOV;
<b>Wireless Presenter</b>	<p>Wireless Presenter</p> <ul style="list-style-type: none"> <li>• The Wireless presentation device allows users with laptops or mobile to connect and present.</li> <li>• The Wireless Presenter should have 1 HDMI or 1 Mini DP/VGA output, and 1 HDMI input</li> <li>• The Wireless Presenter should present minimum 1 users' laptops or handheld devices</li> <li>• The Wireless Presenter Should be able to share uninterrupted HD video with minimum 30fps</li> <li>• The Wireless Presenter should have feature to put random or defined passcode to validate user authentication</li> <li>• 1 x USB 2.0, 1 x RJ45 GB Ethernet.</li> <li>• It should have RS232 and IR port for control and support CEC</li> </ul>

## TECHNICAL SPECIFICATION FOR WEB CONFERENCING AND LECTURE HALL

### 1. CAMERA

Super-low-light 2M pixel sensor for clear and natural imaging in low-light conditions

Resolution: (16:9) 1920 x 1080, 1600 x 900, 1280 x 720, 960 x 540, 848 x 480, 800 x 448, 640 x 360, 424 x 240, 320 x 180; (4:3) 800 x 600, 640 x 480, 480 x 360, 320 x 240 at 60, 30, 15fps

- SmartFrame for automatic FOV adjustment to fit all participants
- True WDR up to 120dB: Superb backlight compensation technology for optimizing light balance in high-contrast conditions
- Zoom: 18X total zoom (12X optical zoom)
- Wide field of view (DFOV): 82°
- Lens focal length: 3.9 mm (wide) ~ 47.3 mm (tele)
- Lens F#: 1.8 (wide) ~ 2.8 (tele)
- Mirror, Flip, AE, white balance: auto, manual override via PTZApp
- Minimum focus distance: 1.5 m
- Standard tripod screw holes and Kensington slot

- Motorized Pan & Tilt Movement
- Pan:  $\pm 170^\circ$
- Tilt:  $+90^\circ$  (up)  $-30^\circ$  (down)
- camera presets (through remote control)
- Fast and quiet pan & tilt movement
- Video Format
- YUV, MJPEG, H.264
- Network video compression format: H.264
- Network protocols: RTSP, RTMP
- Audio Format
- AAC-LC
- Network protocol: RTSP, RTMP
- LAN
- 10/100/1000 Mbps

## **2. SPEAKER PHONE**

Full duplex microphone array with echo cancellation

Advanced noise suppression

Dual-microphone array

3.5 mm phone-in jack

3.5 mm line out

- Speaker: 6W, Adjustable to 90dB SPL at 0.5 m
- Microphone frequency response: 120Hz–16kHz
- Microphone sensitivity:  $-34 \pm 2$  dBV @1KHz, 94dBSPL
- Microphone distortion:  $< 1\%$  from 150Hz
- Microphone support range: Diameter 6M
- Touch controls for volume down/up, mute, phone input, call, and hang-up
- Bridge phone-in and USB into one call
- Security: Kensington slot

## **3. WEB CAM WITH IN BUILT MICROPHONE**

SITC of Web Cam with sensor: 1/2.5"Sony Exmor 4K CMOS sensor

- Frame rate: 4K 30fps; 1080p , 720p , 960x540, 848x480, 800x448, 640x480, 640x360, 424x240, 320x240, 320x180 at up to 60fps
- $120^\circ$  Wide field of view
- Lens iris, focus, zoom: fixed
- AE, white balance: auto, manual override by PTZApp
- Minimum working distance: 80cm
- Back light compensation and 2D noise reduction technology for optimizing light balance in different conditions
- Standard tripod screw holes
- Zoom, Pan, and Tilt Movement
- Zoom: up to 4X leveraging 4K sensor (not available in 4K or 60fps)

- Pan and tilt: when zoomed in leveraging 4K sensor
- Microphone
- 1 uni-directional microphones
- Frequency response: 100~12K Hz
- Sensitivity: -37dB

#### 4. DIGITAL LECTURN

Supply, installation, testing and commissioning of 15.5" IPS interactive touch display with HD resolution, 178° x 178° viewing angle, Brightness: 210 cd/m<sup>2</sup>, Contrast ratio 900:1, Colors depth: 16.7 million, Aspect ratio: 16:9 along with Patented cordless, battery -free pen with 1024 levels of pressure sensitivity for premium signing/writing experience. It should have 2 USB ports to provide easy access to your USB devices, It should have DVI or VGA interface ports. It should be HDCP compliant complete as required.

### TECHNICAL SPECIFICATIONS OF AUDIO

Loudspeaker which shall consist of a 4" woofer and 1" dome tweeter. The loudspeaker shall have an impedance of 8 Ohm and contain a passive built-in crossover network. It shall have 100 Volt built-in line transformer with power taps for 24 Watt, 12 Watt, 6 Watt shall be provided. The connection and installation of the loudspeaker shall be performed using OEM mounting bracket. The direction of the speaker shall be continuously adjustable in all four directions. It shall have an RMS powerhandling of 35 Watt with a maximum power handling of 70 Watt and the frequency response ( $\pm 3$  dB) shall range from 100 Hz to 20kHz. The sensitivity shall be 86 dB when measured with an input signal of 1 Watt at a distance of 1 meter, while the maximum continuous sound pressure level shall be 101 dB. OEM MAF Required

Mixing Channel Amplifeir which shall be 240 Watts or more. It shall have Balanced Audio output. It shall have frequency response of 50Hz- 20000Hz or better. It shall have 4 or more line inputs. It shall have 100V line, 70V line as well as 4 to 16 ohm impedance output. OEM MAF Required. It shall have 4 numbers individual phantom power for all microphone inputs. It shall have minimum impedance load bridged of 4 ohms per channel. It shall have 4 or more balanced microphone inputs.

Bass cabinet which shall be active bass reflex type incorporating a 8" transducer with 2.4" voice coil. One channel shall be used for powering the integrated low frequency transducer. The integrated amplifier shall use audio processing technology and contain three independent controllable channels. The other two channels with an output power of 2 x 150 Watt RMS @ 8 Ohm are used for powering external satellite speakers. It shall have DSP functionalities with filters selectable between low-pass, high-pass and band-pass with Butterworth, Linkwitz-Riley or Bessel characteristics. It shall be supplied with an included wall mounting bracket. It shall have a power handling of 200 Watt, with a frequency response (-10 dB) ranging from 45 Hz to 350 Hz. It shall have 3-pin terminal block connectors for connecting input. The active bass cabinet shall operate on a 100~240 V AC - 50/60 Hz mains network and shall be equipped with a removable power cord. The sensitivity shall be 83 dB when measuring with an input signal of 1 Watt at a distance of 1 meter, while the maximum continuous sound pressure level shall reach 108 dB. The integrated amplifier shall be passive cooled, resulting in zero additionally produced acoustic noise. Integrated circuitry shall protect against short-circuits or mismatched loads and over-heating. The load shall be protected against DC faults and a clip limiter shall automatically reduce the input gain at onset.

Audio source which shall be all-in-one digital audio player, containing an AM/FM tuner and media player supporting WAV, MP3 and WMA file types. Simultaneous operation of tuner and media playback on individual outputs shall be possible. It shall have USB connection, SD/MMC memory card slot and slot-in CD loader allowing playback from the inserted media. It shall have RS-232 Port for Control. The audio source shall operate on a 110~240 V AC / 50~ 60 Hz mains network and shall be equipped with a removable power cord. OEM MAF Required. It shall have frequency response of 20Hz to 20000 Hz or better. It shall be compatible with FAT sixteen and FAT thirty two systems. It shall support playback of wav, mp3 and wmv files. It shall have a power consumption of 10 W or less. It shall have standard 19 inches rack mount chassis. It shall support ID3 and RDS information display. OEM MAF required.

Loudspeakers with Drivers 1x5" LF/1x1" HF; Frequency range 90-20000Hz; Power capacity programm/peak: 250 / 500 W ; Impedance - 8 Ohm; Coverage range (h x v) 110° radial; Sensitivity 1 W / 1 m - 91 dB; SPLmax / 1 m / peak 117 dB with OEM brackets. OEM MAF Required.

Two Channel amplifier with inbuilt DSP, 500W @2ohm , 400W @4 ohm; 400W @8ohm ; 1000W @4Ohm and 800W@8Ohm in bridge mode; Maximum output voltage 115Vpeak and 45Apeak current; Frequency Response 20Hz-20KHz; S/N Ratio- 106dBA; Crosstalk <70dB@1KHz; THD+N < 0.1%; Slew Rate->50V/microSec; Damping Factor >500@ 20-100Hz; A/D and D/A Converters of 24bit/48KHz; DSP Inbuilt Preset Memory; Crossover Filters - linear phase (FIR), Butterworth, Linkwitz-Riley, Bessel: 6 dB/oct to 48 dB/oct (IIR); Input Equalizers - Raised-cosine, custom FiR, parametric iiR: peaking, hi/lo-shelving, all-pass, band-pass, band-stop, hi/lo-pass; Output Equalizer ; Limiters - P TruePowerTM, RMS voltage, RMS current, Peak limiter; Signal output; Network/data 1 x USB plug - Separate input and output DSP, with OEM presets and dante ready. OEM MAF Required.

Four Channel amplifier with inbuilt DSP, 1500W @2ohm , 1200W @4 ohm; 1200W @8ohm and 3000W @4Ohm and 2400W@8Ohm in bridge mode; Maximum output voltage 140Vpeak and 45Apeak current; Frequency Response 20Hz-20KHz; S/N Ratio- 110dBA; Crosstalk >70dB@1KHz; THD+N < 0.2%; Slew Rate- >50V/microSec; Damping Factor >500@ 20-100Hz; A/D and D/A Converters of 24bit/48KHz; DSP Inbuilt Preset Memory; Crossover Filters - linear phase (FIR), Butterworth, Linkwitz-Riley, Bessel: 6 dB/oct to 48 dB/oct (IIR); Input Equalizers - Raised-cosine, custom FiR, parametric iiR: peaking, hi/lo-shelving, all-pass, band-pass, band-stop, hi/lo-pass; Output Equalizer ; Limiters - P TruePowerTM, RMS voltage, RMS current, Peak limiter; Audio signal input 1 x 12 pin Phoenix MC 1.5/12-ST-3.81 - Signal input – MAIN; Loudspeakers 1 x 8 pin Phoenix DFK-PC 4/8-G-7.62 - Signal output; Network/data 1 x USB plug -speakers presets, separate input and output DSP. OEM MAF Required.

Subwoofer with Drivers 2x 10" LF; Frequency range 40 - 400 Hz, Power capacity-programm / peak: 700 / 1400 W ; Impedance - 2x12Ohm or 1x6 Ohms , Sensitivity 1 W / 1 m - 91dB Passive ; SPLmax / 1 m / peak 123dB. OEM MAF Required

Active stereo loudspeakers set comprising 5.25" or more low frequency woofer and 1/2" or more high frequency tweeter. The speaker system shall operate on a 100-240 V, ~50/60 Hz, switchable mains network and shall be equipped with a removable power cord. It shall have RCA or 3.5 mm jack connections for the unbalanced stereo line inputs, It shall have Balanced Mic/ line input on XLR allows connectivity for balanced sources and should have link output to connect to other active speaker. It shall have a max power handling of 100W and the frequency response (-10 dB) shall range from 60 Hz to 20 kHz. It should come with Original OEM wall mount bracket.

maximum continuous sound pressure level of 102 dB (1W/1M) or better. OEM MAF Required.

Central Control Unit-Supply of The Audio Powering Switch shall be responsible for routing, controlling and processing the audio and supplies power to the multimedia devices. It includes an intelligent adaptive acoustic feedback suppressor, echo cancellation and two 5-band parametric equalizers for optimal speech intelligibility.

- Zero network configuration
- Fully compatible to the Ethernet (IEEE802.3) and OMNEO standard
- Supports loop-through connection with cable redundancy
- Standby mode to be environment friendly
- Mains switch on the rear to power on the audio powering switch.
- Ground-lift switch.
- Led on the front to show: green (power on), amber (standby), blinking (no connection to the system).
- Ethernet led's yellow and amber for each socket.
- Independent powered sockets; a short circuit on one socket does no influence the other sockets.
- Supports hot plug and play.

Chairman Unit- The extended discussion device shall have a 4.3 inch touch screen and it shall be completely software upgradable. It shall have a lot of features including independent dual-use for language selection and voting. It shall have a simple software setting to enable two participants to share a device and listen to proceeding in two different languages.

The 4.3 inch capacitive touch screen shall inform participants of the proceedings and increases meeting efficiency by displaying the current speaker and delegates in the request list.

The device shall have the following features and benefits:

- Single-use and chairperson can be configured via the PC configuration software application.
    - Supports star and loop-through connection.
    - capacitive multi-touch screen for displaying:
      - Multiple user interface languages in original characters.
      - Speaker list and Request list. Screen size 109.22 mm (4.3 inch)
- Screen type capacitive multi-touch  
 Supply voltage 48 Vdc  
 Power consumption Max 5W  
 Frequency response 100 Hz – 20 kHz (-3 dB at nominal level)  
 THD at nominal level < 0.1 %  
 Dynamic range > 90 dB

Signal-to-noise ratio > 90 dB The 'pluggable high-directive microphone' shall be a stylish high-directive microphone that shall give the user a clear view of the meeting room, due to its unobtrusive design. The high-directive microphone shall contain two precisely positioned capsules to give it a high-directive response. This shall make it possible to have a larger speaking distance than normal from the microphone, even in noisy conditions.

The microphone shall have the following features and benefits:

- Discrete microphone for user convenience.
- High-directive response.
- Ultra-low noise.

- Low susceptibility to interference from mobile phones.

The microphone shall have the following controls and indicators:

- Red or green illuminator. Red shall indicate that the microphone is active; green shall indicate that the request-to-speak is accepted. Frequency Bandwidth 100 Hz – 15 kHz according IEC60914

Dynamic range > 96 dB

Delegate Unit-Supply of The discussion device shall have the following features and benefits:

- Supports star and loop-trough connection.
- Dual-use functionality enabled by use of software.
- Audio mute button
- Encryption ensures that information within the system remains confidential

The device shall have a headphone connection and independent volume control (on both sides of the device), so the speaker can be heard clearly even when there is excessive background noise

Frequency response 100 Hz – 20 kHz (-3 dB at nominal level)

THD at nominal level < 0.1 %

Dynamic range > 90 dB

Signal-to-noise ratio > 90 dB

Operating temperature 5 °C to +45 °C The ‘pluggable high-directive microphone’ shall be a stylish high-directive microphone that shall give the user a clear view of the meeting room, due to its unobtrusive design. The high-directive microphone shall contain two precisely positioned capsules to give it a high-directive response. This shall make it possible to have a larger speaking distance than normal from the microphone, even in noisy conditions.

The microphone shall have the following features and benefits:

- Discrete microphone for user convenience.
- High-directive response.
- Ultra-low noise.
- Low susceptibility to interference from mobile phones.

The microphone shall have the following controls and indicators:

- Red or green illuminator. Red shall indicate that the microphone is active; green shall indicate that the request-to-speak is accepted. Frequency Bandwidth 100 Hz – 15 kHz according IEC60914

Dynamic range > 96 dB

#### **Wired handheld mic with mic stand**

Handheld Wireless Mic with Cardioid polar pattern for transmitter, Dynamic microphone with Neodymium magnet, Receiver frequency response 80Hz-18kHz, Receiver RF sensitivity < 1.0 µV, Receiver Image rejection > 55dB, Receiver Dynamic range > 95dB and receiver having 32 channels possible, Receiver S/N ratio > 100dB A, distortion < 1 %, Transmitter sensitivity - 3.2 mV/Pa, modulation: +/-40kHz

Wireless Lapel Mic with Cardioid polar pattern for transmitter, Receiver & Transmitter frequency response 100Hz-18kHz or better, Receiver RF sensitivity < 1.0 µV, Receiver Image rejection > 55dB, Receiver Dynamic range > 95dB and receiver having 32 channels

possible, Receiver S/N ratio >100dB A, distortion <1 %, Transmitter sensitivity - 5.6 mV/Pa, modulation: +/-40kHz .

### **Wireless Presenter**

- The Wireless presentation device allows users with laptops or mobile to connect and present.
- The Wireless Presenter should have 1 HDMI or 1 Mini DP/VGA output, and 1 HDMI input
- The Wireless Presenter should present minimum 1 users' laptops or handheld devices
- The Wireless Presenter Should be able to share uninterrupted HD video with minimum 30 fps
- The Wireless Presenter should have feature to put random or defined passcode to validate user authentication
- 1 x USB 2.0, 1 x RJ45 GB Ethernet.
- It should have RS232 and IR port for control and support CEC

Ceiling Microphone which shall be a designed for fixed installation. The microphone shall fit within the space of a standard six hundred mm<sup>2</sup>. Ceiling panel and shall be mountable either onto or flush with the ceiling itself. The microphone shall consist of at least 26 pre-polarized condenser microphone capsules and shall use beam forming technology that automatically focuses on whoever is speaking in the room. The microphone shall be supplied complete with a ceiling suspension kit for ceiling installation, an external power supply unit, a power cable for connection to the external power supply unit, an audio cable for connection to the DSP and a control cable. The microphone shall also feature an RJ-45 network socket for connecting a computer for configuration purposes, a Reset button for performing a restart of the microphone, and a Reset LED that lights up when mains voltage is present. The microphone shall also be able to configure through a PC /Tablet via configuration software for easy changes if any required. The microphone sensitivity shall be 0 dBV/Pa (nine hundred eighty eight mV/Pa). The maximum sound pressure level shall be one hundred four dB SPL, equivalent noise level shall be twenty dB(A). The dynamic range shall be ninety three dB (A). Operating voltage shall range from twenty to twenty eight Volt Direct Current. It shall have automatic beam forming technology, it automatically detects the active speaker in the room with integrated microphone capsules and follows him. It shall have Dante™ interface with two RJ-45 sockets Primary and Secondary. OEM MAF Required.

Digital Signal Processor which should be having Six AEC enabled Microphone/ line inputs. The DSP should support noise reduction, Microphone mixing, Low, Mid and high frequency Equalization, Input gain control, individual Microphone Input phantom power control. The DSP should have additional two line inputs which may be used for future applications. The DSP should be having Six Audio line outputs. The DSP should have USB Audio Port which should get integrated with the unified for Echo free communication between the locations.

## **9. Displays**

1. 4K LED Display which shall have Screen Size of 42 inches or more. It shall have an aspect ratio of 16:9, 4:3 or better. It shall have native resolution of 3840X2160 or more. It shall have brightness of 400cd/m<sup>2</sup> or more. It shall be with static contrast ratio of 1200:1 or more. It shall have viewing angle of 178X178 or more. It shall have 3 or more HDMI 2.0 Input, 1 or more USB Port or better. It shall have optical Audio Out. It shall have Speaker output of 10W+10W or better. It shall have RS-232 control port. It shall have RJ-45 port. It shall support Time Scheduler, RJP Mode, One Channel Map and Embedded Content Manager. It shall support Functions like USB Cloning, IR Out, Multi IRCL on. It shall have CI Slot interface. It shall have RF Port, Debug Port and Optical Audio Out Port. It shall have Web browser, soft app, wi-fi (ac), bluetooth audio playback. It shall support mobile connection overlay. It shall have a Dynamic CR of Ten Lakh to One or better. It shall have min/max Energy Conservation of Sixty Eight/Thirty Three or better. It shall have a typical Power consumption of 93 Watts or less. It shall be supplied with Remote controller, Power cord as included accessories. It shall be supplied with 5 meters HDMI Type A to Type A which shall support data rate of up to 18 Gbps. It shall support resolutions of up to 3820x2160@60 Hz or better. It shall have Gold Plated Contacts for Signal Integrity. It shall have an insulation resistance of 100 ohms or better. It shall have a Dielectric Strength of 500V/minute or better. It shall be HDMI 2.0 or better. It shall have up to 1536 KHz or better Audio Sample Frequency for highest audio fidelity. It shall be highly resistant with RF and EMI interference. It shall work without the use of External Power Supplies. 400 or +/- 50 nits. OEM MAF required. Requirements of the color graphic sub system include:
  
2. 4K LED Display which shall have Screen Size of 65 inches or more. It shall have an aspect ratio of 16:9, 4:3 or better. It shall have native resolution of 3840X2160 or more. It shall have brightness of 350cd/m<sup>2</sup> or more. It shall be with static contrast ratio of 1300:1 or more. It shall have viewing angle of 178X178 or more. It shall have 3 or more HDMI 2.0 Input, 1 or more USB Port or better. It shall have optical Audio Out. It shall have Speaker output of 10W+10W or better. It shall have RS-232 control port. It shall have RJ-45 port. It shall support Time Scheduler, RJP Mode, One Channel Map and Embedded Content Manager. It shall support Functions like USB Cloning, IR Out, Multi IR CLoning. It shall have CI Slot interface. It shall have RF Port, Debug Port and Optical Audio Out Port. It shall have Web browser, soft app, wi-fi (ac), Bluetooth audio playback. It shall support mobile connection overlay. It shall have a Dynamic CR of Ten Lakh to One or better. It shall have a typical Power consumption of 179 Watts or less. It shall be supplied with Remote controller, Power cord as included accessories. It shall be supplied with 10 meters HDMI Active Optical Cable Type A to Type A which shall support data rate of up to 18.2 Gbps. It shall support resolutions of up to 3820x2160@60 Hz or better. It shall have a Power Consumption of 250mV or better. It shall support lossless signal transmission up to 100 meters or better. It shall be HDMI 2.0 or better. It shall support HDCP 2.2 or better. It shall have an outer cable diameter of 4mm or less. It shall be highly resistant with RF and EMI inter.
  
3. 4K LED Display which shall have Screen Size of 75 inches or more. It shall have an aspect ratio of 16:9, 4:3 or better. It shall have native resolution of 3840X2160 or more. It shall have brightness of 350cd/m<sup>2</sup> or more. It shall be with static contrast ratio of 1300:1 or more. It shall have viewing



angle of 178X178 or more. It shall have 3 or more HDMI 2.0 Input, 1 or more USB Port or better. It shall have optical Audio Out. It shall have Speaker output of 10W+10W or better. It shall have RS-232 control port. It shall have RJ-45 port. It shall have response time of 9ms or better. It shall support Time Scheduler, RJP Mode, One Channel Map and Embedded Content Manager. It shall support Functions like USB Cloning, IR Out, and Multi IR Cloning. It shall have CI Slot interface. It shall have RF Port, Debug Port and Optical Audio Out Port. It shall have Web browser, soft app, wi-fi (ac), Bluetooth audio playback. It shall support mobile connection overlay. It shall have a Dynamic CR of Ten Lakh to One or better. It shall have min/max Energy Conservation of Sixty Eight/Thirty Three or better. It shall have a typical Power consumption of 179 Watts or less. It shall be supplied with Remote controller, Power cord as included accessories. It shall be supplied with 10 meters HDMI Active Optical Cable Type A to Type A which shall support data rate of up to 18.2 Gbps. It shall support resolutions of up to 3820x2160@60 Hz or better. It shall have a Power Consumption of 250mV or better. It shall support lossless signal transmission up to 100 meters or better. It shall be HDMI 2.0 or better. It shall support HDCP 2.2 or better. It shall have an outer cable diameter of 4mm or less. It shall be highly resistant with RF and EMI interference. It shall work without the use of External Power Supplies 400 or +/- 50 nits. OEM MAF required.

4. LED display which shall have Screen Size of 98 inches or more. It shall have IPS Panel Technology or better. It shall have an aspect ratio of 16:9. It shall have native resolution of 3840X2160 or more. It shall have brightness of 350cd/m2 or more. It shall be with static contrast ratio of 1300:1 or more. It shall have viewing angle of 178X178 or more. It shall have 3 HDMI Input, 1 or more Display Port, 1 or More DVI-D, Audio input Port or better. It shall have at least 1 Video output in the form of HDMI or DVI-D or Display Port. It shall have at least 1 Audio Output Port as well as external speaker out. It shall have RS-232 input as well as output port. It shall have RJ-45 port and IR receiver. It shall support Portrait and Landscape Orientation. It shall have 14.9mm or lesser even bezel. It shall have a typical Power consumption of 318 Watts or less. It shall have 24\*7 usage capability. It shall be IEC / EN / UL Sixty Thousand Nine Hundred Fifty happen one certified for safety. It shall have real time monitoring and control and multi screen mode upto 4 screens along with PIP with both main screen and sub screen at the same time. It shall be supplied with Remote controller, Power cord, IR/Light sensor receiver, CD (Manual), RS232C as an included accessory. It shall be FCC Class A certified. it shall be CE and KC certified for EMC. It shall be supplied with 10 meters HDMI Active Optical Cable Type A to Type A which shall support data rate of up to 18.2 Gbps. It shall support resolutions of up to 3820x2160@60 Hz or better. It shall have a Power Consumption of 250mV or better. It shall have a dynamic bend radius of 80mm or better. It shall have a static bend radius of 40mm or better. It shall support lossless signal transmission up to 100 meters or better. It shall be HDMI 2.0 or better. It shall support HDCP 2.2 or better. It shall have an outer cable diameter of 4mm or less. It shall be highly resistant with RF and EMI interference. It shall work without the use of External Power Supplies 400 or +/- 50 nits. OEM MAF required.

## **LIST OF APPROVED MAKES**

**LIST OF APPROVED MAKES****INTERIOR FITOUT WORKS**

<b>SL.No.</b>	<b>Description of Material</b>	<b>Approved Make /Manufacturers</b>
1	Reinforcement Steel (HDSD TMT)	TATA / SAIL / RINL / TISCO
2	Cement OPC Cement PPC	Ultratech / Ambuja / J K / Wonder
3	White Cement	JK / Birla
4	Structural steel-MS Plates	TATA / SAIL / JINDAL / RINL
5	Structural steel-Tubular sections/RHS/SHS/CHS	SAIL / JINDAL / RINL / APL-APOLLO
6	Stainless steel	SAIL / JINDAL / TATA
7	Ply/Board/Veneer	Duro /Century/ Green Ply
8	Aluminium Section	Jindal / Hindalco / Indalco
9	MDF	Duro /Century/ Green Ply
10	Flush doors	Duro / Century /Green Ply
11	Laminate	Merino / Greenlam / Formica
12	Glass/Toughened Glass	Asahi / Saint Gobain / Pilkington
13	Mirror	Asahi / Saint Gobain / Pilkington
14	Fire rated glass	Asahi / Saint Gobain / Glaverbal
15	Hardware for glass Patch Fittings	Dorma / Assa abloy / Blum/ Stronel
16	Hardware fitting for Flush doors	Dorma / Assa abloy / Blum /Stronel
17	Canopy / skylight Patch fittings / spider fittings	Dorma / Assa abloy / Blum/Ozone
18	Wooden / Metal Fire rated doors	Navair International Pvt. Limited / Shakti Horman / Kutty / ASES Security
19	Fire door hardware	Becker FS/ Dorma/ Hettich
20	Water proofing	Dr Fixit/Pidilite/Ceco/Impermo
21	Vitrified Tiles (Double Charge)	HR Johnson / Orient Bell / Kajaria / Nitco
22	Ceramic glazed tiles	HR Johnson / Orient Bell / Kajaria / Nitco
23	Carpet Tiles	Milliken / Standard / Sumione/ Shaw
24	Plastic emulsion Paint/Texture paint	Oikos, Asian paints, Acro paint, Berger, Johnson and Nicholson
25	Fire Rated Paint	Hilti / Promat / Navair International/ Viper

26	Gypsum board/ Moisture resistance board for False ceiling	Saint Gobian Gyproc / USG Boral
27	Mineral Fiber Ceiling	Armstrong/ Daiken/ Hunter Douglas
28	GI Grid Ceiling	Armstrong/ Trac/ Hunter Douglas
29	Baffle ceiling	Armstrong / Hunter Douglas
30	Kitchen Equipment	Kaapi Solutions / Simple Kitchen / Relief
31	JAP Partitions	JEB/ Dorma
32	Roller Blinds	Vista / Livin / HunterDouglas / Rosselle
33	Silicon Sealant	Dow corning / Sikka / Wacker / McCoy
34	Wall Paper	Eden / Marshall / Elemento
35	Lacquered Glass	Saint Gobain/Asahi India/Modi/ Guardian
36	Automatic Sliding Doors	Dorma / Autoingress/Stronel/Geze
37	Signages	Egromax/ Rosselle/ ASES
38	Frosted film	3M / Avery
39	Fiber Glass Insulation	UP Twiga / Rockwool

**PLUMBING WORK**  
**LIST OF APPROVED MAKE**

<b>SL.No.</b>	<b>Description of Material</b>	<b>Approved Make /Manufacturers</b>
1	Vitreous China Sanitaryware (1st class quality)	Hindware / Cera / Parryware
2	C.P fittings	Hindware / Cera / Parryware/Jaquar
3	C.P Bottle Trap	Hindware / Cera / Parryware/Jaquar
4	Stainless Steel Sink	Cera/ Neelkanth / Jayna
5	Bath Room C.P accessories	Hindware / Cera / Parryware/Jaquar
6	Health Faucet (With S/S)	Hindware / Cera / Parryware/Jaquar
7	G.I. pipes (Up to 150 mm dia)	Jindal Hissar / APL / Apollo / TATA
8	UPVC pipes & Fittings	Rallison / Aashirwad / SFMC
9	CPVC pipes & Fittings	Rallison / Aashirwad / SFMC
10	P TRAP	McALPINE / Cera
11	G.I.Fittings (Malleable)	UNIK / DRP / TATA
12	Ball valve	Deepak / LP / Zoloto
13	Butterfly Valve	Deepak / LP / Zoloto
14	Hand Drier	Hindware/Cera
15	Pumps	Kirloskar, ABB, Grundfos
16	HDPE/ MDPE pipe	WL Plastics/ Noble/ Apollo

<b>LIST OF APPROVED MAKE (E&amp;M)</b>		
<b>S.No.</b>	<b>Description of Material</b>	<b>Approved Make</b>
<b>Conduits, Cables &amp; Wires:</b>		
1	MS black enameled, Galvanized ERW conduits	AKG, BEC, Steelkraft
2	GI pipes	Tata, Jindal, SAIL
3	PVC Conduit	Precision, BEC, AKG
4	PVC Conduit Accessories	Precision, BEC, AKG
5	MS Conduit accessories	AKG, BEC, Steelkraft
6	1100 volts grade XLPE cables	Finolex, KEI, RR, Havells, Gloster
7	1100 volts grade PVC control cables	Finolex, KEI, RR, Havells, Gloster
8	FRLS copper conductor wires	Finolex, KEI, RR, Havells
9	LT Fire survival Cables	Finolex, KEI, RR, Havells
10	Cable lugs	Dowell's, Raychem, Comet
11	Cable compression glands	Dowell's, Raychem, Comet
<b>Lighting, Fan &amp; Switches</b>		
1	LED Type Internal Light Fixtures (Linear, Recessed, Downlighter, etc.)	Signify, LT, Regent, Osram, Bajaj, CG, Halonix
2	External, Outdoor Landscape	Signify (CK), LT, Regent, Osram, Bajaj, CG, Halonix
3.	BLDC Fans	Havells, Atomberg, Halonix, Bajaj
4.	Exhaust Fans	Halonix, CG, Bajaj, Usha, Havells
5	Modular switches, socket outlets and wiring accessories with moulded cover plate	ABB(Ivie), Schneider(Zencelo), Legrand (Arteor), MK Honeywell (Blenze plus)

<b>Panels, DB &amp; Switchgears</b>		
1	Power Distribution Panels (non-TTA)	Neptune, Advance Panels, Ambit, Adlec Systems, Tricolite
2	MV/ LV Switchboards,	Schneider, Legrand, Siemens, ABB
3	Rising mains (powder coated, Sandwich type)	Schneider, Legrand, Siemens, ABB
3	Moulded Case Circuit Breakers (with rotary handle) (variable settings)	Siemens (3VA), ABB (T-Max), Schneider (NSX), Legrand (DPX3)
4	Protective Relays (Microprocessor)	Alstom , Siemens , ABB , Schneider
5	MV Contactors, Timers (Solid state)	Siemens, ABB, Schneider, Legrand
6	Miniature Circuit Breaker	Siemens-Betagard, ABB-SB series, Schneider-Acti9, Legrand- DX3
7	Earth Leakage Circuit Breaker	Siemens-Betagard, ABB-SB series, Schneider-Acti9, Legrand- DX3
8	Measuring Meters	Siemens, ABB, Schneider (Conserv)
9	Cast resin Current Transformers	Automatic Electric , Kappa , Gilbert Maxwell , Precise
10	Selector Switches	Kaycee, Siemens, Salzer
11	Indication lamps (LED type) and Push Buttons	Siemens, ABB, Schneider, Legrand
12	MCB Distribution Boards in sheet steel housing (double door)	Siemens-Betagard, ABB-ITUS, Legrand-Ekinox3, Schneider-Acti9
13	Timers	Siemens, ABB, Schneider, Legrand(DX3)
14	Single phase preventer (current base)	Minilec , Siemens , Legrand
15	Cable tray	Indiana (Vadodara), MEM, Profab (PUK), Legrand
16	Raceway	Indiana (Vadodara), MEM, Profab (PUK), Legrand
<b>Earthing &amp; Lightning Protection</b>		
1	MF Earthing with GEM	Alkemee, Karytron, Taelman, Shubhra

2	Lightning Protection System as per IEC-62305	Dehn, OBO, ABB, Altec
<b>UPS</b>		
1	True Online Double Conversion UPS System	ABB, Schneider (APC), Numeric (Legrand)
2	Sealed Maintenance Free Batteries	Exide, Amar Raja, Hitachi, Panasonic
<b>Lifts</b>		
1	Lifts	Schindler, Mitsubishi, Otis
<b>Fire Fighting</b>		
1	Fire Extinguishers	Omax, Safeguard, Padmini, Newage
2	MS Pipes	Jindal Hisar, Tata, SAIL
3	Expansion Joint	Easyflex, Dunlop, Vimpe
4	Butterfly Valves	Zoloto, Advance, Kartar, G-Tech
5	Hydrant Valve	Newage, Omax, Kalpex, G-Tech
6	Check Valve/ NRV/Ball Valve	Zoloto, Advance, Kartar, G-Tech
7	Hose Pipe/Branch Pipes	Newage, Omax, Kalpex, G-Tech
8	Firemen's Axe	Safeguard, Safex, Newage
9	Fire Brigade connection/ draw out connection	Newage, Omax, Kalpex, G-Tech
10	Strainer	Kartar, Sant, Honeywell
11	Flow Detectors	System Sensor, Honeywell, Switzer
12	Sprinklers	HD, Newage, G-Tech
13	FHC	ASES, Sehgal Door, G-Tech
14	Pumps	Kirloskar, ABB, Grundfos



<b><u>LIST OF APPROVED MAKES (HVAC)</u></b>		
<b>S.No.</b>	<b>Description Of Material</b>	<b>Approved Make</b>
1	VRF Units	Daikin, Mitsubishi Electric, O-General, Hitachi
2	Enthalpy Recovery Wheel (HRW/ ERU)	DRI, Zeco, Munters
3	Air Filter	Thermadyne , Camfil , Airtech
4	Heavy Duty Drain Piping	Polypack , Supreme , Prince , Finolex
5	GI Sheets	Tata, SAIL, Jindal (Hissar)
6	Modular AHU, TFA	Zeco, Stulz, Systemair
7	Factory Fabricated Duct-Rectangular	Zeco , Ductofab , Projtech , Eco Duct
8	Extruded Aluminum Powder Coated Grilles , Diffusers , Slot Dampers , Volume Control Dampers , Factory Fabricated Diffuser Outlet Boxes With Diffusion Plate	Systemair , Carryaire , Airflow
9	Stick Pin	Airflow , Prima Seal
10	Fire Dampers	Systemair , Servex , Airflow , Belimo , Seimens
11	Fire Dampers Actuator	Belimo , Honeywell , Seimens , Airflow
12	Inline Fans, Propeller Fan	Systemair , Green Heck , Kruger , Caryaire, Air Flow
13	Axial Fans	Systemair , Kruger , Green Heck , Humidin, Air Flow
14	Centrifugal Fans	Systemair , Kruger , Green Heck , Humidin, Air Flow
15	Fan Section,Cabinet Fan	Systemair, Kruger, Green Heck, Humidin, Air Flow
16	Air-Washer	Symphony, Systemair, Zeco
17	Scrubber	Trion, Rydair, Zeco
18	Accosound Insulation for Accoustic Lining of Ducts and AHU Room	Paramount, Armacell , K-Flex, Supreme
19	Cross Linked Closed Cell Oxide Acetate Foam Thermal Insulation for Ducts	Paramount, Armacell, K-Flex, Supreme
20	Refrigerant Copper Piping	Rajco, Mandev, Maxflow, Daikin-Jobu
21	Polysiloxane Coating	Oxycoats, Jemkon , Technocrats Polycoats
22	Adhesive	Foster, Paramount Polytreat, Fevicol
23	Cushy Foot Mounts	Dunlop, Resistoflex , Easyflex
24	Brazing Rods	Diamond, Totaline, Harries
25	Paints	Dulex-ICI, Berger, Asian
26	VI Pads	Resistoflex , Easyflex
27	Air-Curtain	Mitzvah, VTS, Almonard
28	Variable Speed Drives	Danfoss, ABB, Schneider, Seimens

29	UVGI Air Purifier	Magneto, Honeywell, Alfaa
30	VSD/ VFD Panels	Neptune, Advance Panels, Ambit, Adlec Systems, Tricolite
31	Air Differential Pressure Switch	Anergy, Siemens, Honeywell
32	Temperature & Rh Sensor and Adjuster Package	Anergy, Siemens, Honeywell
33	Air Differential Pressure Sensor and Adjuster Package	Anergy , Siemens, Honeywell
34	Precision Air-Conditioners (PAC)	Vertiv-Emerson, Stulz, Bluebox

<b><u>LIST OF APPROVED MAKES</u></b>		
<b>LOW VOLTAGE WORKS</b>		
<b>LIST OF APPROVED MAKE</b>		
<b>SL.No.</b>	<b>Description of Material</b>	<b>Approved Make /Manufacturers</b>
<b>FIRE ALARM/PA SYSTEM</b>		
1	addressable fire alarm control panel	Siemens (Cerberus), Bosch, Notifier
2	Active Repeater Panel.	Siemens (Cerberus), Bosch, Notifier
3	Intelligent addressable Multicriteria detector (Smoke + thermal).	Siemens (Cerberus), Bosch, Notifier
4	Intelligent addressable Smoke detector	Siemens (Cerberus), Bosch, Notifier
5	intelligent addressable Heat detector.	Siemens (Cerberus), Bosch, Notifier
6	Addressable Control Relay Module	Siemens (Cerberus), Bosch, Notifier
7	Addressable Module with one input & one output contacts,	Siemens (Cerberus), Bosch, Notifier
8	Response Indicator with matching screws	Siemens (Cerberus), Bosch, Notifier
9	addressable manual break glass unit ( Double action)	Siemens (Cerberus), Bosch, Notifier
10	Stand alone Loop Powered sounder	Siemens (Cerberus), Bosch, Notifier
11	Stand alone Loop Powered Strobe with inbuilt isolators	Siemens (Cerberus), Bosch, Notifier
12	Addressable Duct detector	Siemens (Cerberus), Bosch, Notifier
13	Beam Detector	Siemens (Cerberus), Bosch, Notifier
14	Fire Survival Armoured cable	Finolex, KEI, RR
15	PA controller	Bosch, Biamp, Atlas IED, Notifier, JBL
16	Router monitoring.	Bosch / Notifier / JBL
17	Amplifier.	Bosch, Biamp, Atlas IED, Notifier, JBL
18	Call Station	Bosch, Biamp, Atlas IED, Notifier, JBL
19	wall mount speaker	Bosch, Biamp, Atlas IED, Notifier, JBL
20	ceiling mount certified speaker	Bosch, Biamp, Atlas IED, Notifier, JBL
21	CD/DVD Player	Sony / Samsung
22	Volume control units 12,36,100W	Bosch / Notifier / JBL
23	Equipment Rack	MTS / Rittal / APW/ Valrack
24	Workstation ( i-7 PC, with 8 GB RAM and 1 TB HDD, 10/100 Mbps Ethernet card	HP / DELL / IBM
25	Fire Rated Speaker Cable	Crestron, Extron, Belden
26	Graphics Software	Siemens (Cerberus), Bosch, Notifier

<b>ACCESS CONTROL SYSTEM/PANIC BAR</b>		
1	I.P Controller	Bosch, Prowatch-Honeywell, Lenel, Rosslare
2	Card Readers	Bosch, Prowatch-Honeywell, Lenel, Rosslare
3	Relay Boards	Bosch, Prowatch-Honeywell, Lenel, Rosslare
4	Biometric reader	Bosch, Prowatch-Honeywell, Lenel, Rosslare
5	Bluetooth smart card readers	Bosch, Prowatch-Honeywell, Lenel, Rosslare
6	electromagnetic locks/ electric lockset	Assa A bloy, Bel, Defikas, Kaba
7	exit buttons	Bosch, Prowatch-Honeywell, Lenel, Rosslare
8	smart cards	Bosch, Prowatch-Honeywell, Lenel, Rosslare
9	Magnetic Door Contact	CWT, Security Exchange, Kaba
10	Buzzer	CWT, Security Exchange, Kaba
11	DFMD	Rapiscan, Astrophysics, Smiths, Safe-gate, Samarth Security
12	Panic bar with electric latch retraction.	Dafikas / Dorma
13	Hand held metal detector	Rapiscan, Astrophysics, Smiths, Safe-gate, Samarth Security
14	Access Control Software	Bosch, Prowatch-Honeywell, Lenel, Rosslare
15	Cables for ACS	Excel / Bonton/ KEI/
16	PVC conduit	Precision, BEC, AKG, RMG
<b>CCTV SYSTEM</b>		
1	Dome camera	Bosch, Pelco, Axis, Honeywell-Equip
2	Bullet Camera	Bosch, Pelco, Axis, Honeywell-Equip
3	Two-way Audio Input	Bosch, Pelco, Axis, Honeywell-Equip
4	PTZ Camera	Bosch, Pelco, Axis, Honeywell-Equip
5	Hard Drives	WD / Seagate
6	LED Display	Samasung / LG / Sony
7	Access Control Server	HP / DELL/Cisco
<b>PASSIVE NETWORKING COMPONENTS</b>		
1	Unshielded Twisted Pair	Belden, Systemax, Siemon, Schneider
2	24 Port Patch panels	Belden, Systemax, Siemon, Schneider
3	Face Plate	Belden, Systemax, Siemon, Schneider
4	CAT6A/ CAT6 /RJ45 Cable	Systemax, Siemon, Belden
5	Fiber Cable Multimode	Belden, Systemax, Siemon, Schneider
6	Telephone Tag Blocks	Krone/ Pouyet/ TVS

7	Cable TV Wire	Siemon, Belden, Cisco, Commscope
8	Telephone Wire/ Co-Axial	Havells, Finolex, LAPP
<b>NETWORK</b>		
1	Network Rack	APW-Vero President, Rittal, Valrack
2	Chasis Based Core Switch	Extreme / Cisco / Juniper/ Arista
3	Core switch	Extreme / Cisco / Juniper/ Arista
4	Edge switch	Extreme / Cisco / Juniper/ Arista
5	Modules 10GBASE-SX SFP, MMF 220 & 550 meters,	Extreme / Cisco / Juniper/ Arista
6	Wireless Controller	Extreme / Cisco / Juniper/ Arista
7	Dual radio 2x2, 4x4 802.	Extreme / Cisco / Juniper/ Arista
8	Network Management System	Extreme / Cisco / Juniper/ Arista
9	Server for NMS+Controller	HP / Dell /Cisco
10	1U RACK Server	HP / Dell /Cisco
11	Fire Wall, Unified Protection (UTM)	Fortinet, Cisco, Palo Alto
<b>Voice Solution</b>		
1	IPPBX	Cisco, NEC, Tadiran
2	IP Phones	Cisco, NEC, Tadiran
<b>Server Room PAC, Room temperature and humidity monitoring Unit</b>		
1	9.5 Tr Precision AC Unit	Blue Box Swegon / Vertiv / Schneider
2	Precision AC unit	Blue Box Swegon / Vertiv / Schneider
<b>Audio</b>		
1	Wall mount loudspeaker	Audac / QSC/ BOSE
2	Digital channel power amplifier	Audac / QSC/ BOSE
3	Professional Media Player	Audac / QSC/ BOSE
4	Dual channel power amplifier	Audac / QSC/ BOSE
5	Sound Bar	Audac / QSC/ BOSE
6	Power amplifier	Audac / QSC/ BOSE
7	Compact Powered Bass Reflex Cabinet	Audac / QSC/ BOSE
8	Ceiling Speakers	Audac / QSC/ BOSE
9	Central Control Unit Audio Conferencing	Audac / QSC/ BOSE
10	Digital Chairman Unit	Senheiser / Shure/ Beyerdyanamics
11	Delegate Unit Discussion Devices	Senheiser / Shure/ Beyerdyanamics
12	Wireless handheld / lapel / headworn microphone	Sennheiser / QSC/ BOSE
13	Wireless digital Handheld Microphone	Sennheiser / QSC/ BOSE
14	Wireless Lapel Mic	Senheiser / Shure/ Beyerdyanamics
15	Wireless Presenter	Crestron/Clickshare/AMX

16	Ceiling Microphone	Senheiser / Shure/ Beyerdynamics
17	Digital Signal Processor	Sennheiser / QSC/ BOSE
<b>Accessories</b>		
1	AV Connectivity FacePlate	Logic/Kramer/Crestron / Custom
2	Pro Grade 2 Core Shielded Audio Cables - In Mtr	Crestron / Extron / Beldon
3	Pro Grade 4 Core Control Cable - In Mtr	Crestron / Extron / Beldon
4	Pro Grade 16 AWG Speaker Cable - In Mtr	Crestron / Extron / Beldon
5	Rack 9U,12 U, 24U, 27U, 42U	APW-Vero President, Rittal, Valrack
6	Rack 24 U	APW-Vero President, Rittal, Valrack
7	Patch Cord HDMI 2.0 - 2Mtr	Crestron / Extron / Beldon
8	Patch Cord Audio - 2Mtr	Extron / Crestron / Beldon
9	PDU	Vertive/ Legrand/ Schneider
<b>Display</b>		
1.	LED Display	Samsung/ Penasonic/LG
2	Projector	Sony/ Barco/ Christie

**Notes:**

- 1 The brands/makes of the items would be executed as per the “**List of Approved Makes**” provided in the Tender Document. However, colour coding, shade or design shall be the discretion of the Engineer.
- 2 In case of non-availability of the brand/make specified in the approved list, the agency shall be allowed to use alternate equivalent brands of the material subject to approval of the same from Engineer/DFCCIL.
- 3 The agency has to submit requisite catalogues and samples of the material to Engineer/DFCCIL before approval and ensure that the supply would only be taken by agency after the materials are duly approved by DFCCIL.
- 4 The agency has to produce Manufacturer Test Certificates (MTC), Warranty Certificates/Invoices for material/equipment supplied for certification and approval.
- 5 Submittals and samples must be approved from Engineer/DFCCIL before supply.

# **PART-III**

## **CHAPTER-I**

# **MILESTONES AND TIME SCHEDULE**

## **PART-III**

### **CHAPTER - I**

#### **MILESTONES AND TIME SCHEDULE**

##### **1.1.1 Time Schedule:**

###### **1.1.1.1 Time of start and completion:**

The time allowed for execution of the works is **09 (Nine Months)** from the date of issue of letter of acceptance from DFCCIL.

If the contractor commits defaults in commencing execution of the works as afore stated, DFCCIL shall without prejudice to any other right to remedy, be at liberty to forfeit fully the Earnest Money Deposit and performance guarantee of the contractor.

###### **1.1.1.2 Progress of works:**

The contractor shall submit a programme of work in the form of a Bar Chart of all the activities in consistence with milestone target envisaged below. In case this bar chart requires to be modified, the DFCCIL and the contractor shall agree upon a time and progress chart. The chart shall be prepared in direct relation to the time stated as **09 months** for the completion of the works as the milestone targets specified below of these special conditions. It shall indicate the forecast of the dates of commencement and completion of various activities of the work and may be amended as necessary by agreements between the DFCCIL and the contractor within the limitation of **09 months** as overall completion period.