NEPAL ELECTRICITY AUTHORITY

(An Undertaking of Government of Nepal)

Project Management Directorate

Distribution Line and Substation Department

DISASTER RECOVERY CENTRE PROJECT

BIDDING DOCUMENT
FOR

Design, Supply, Installation and Commissioning of Disaster Recovery Centre (DRC), Private Cloud Infrastructure and Data Centre Interconnect (DCI)

(Procurement of Plant)

Single-Stage, Two-Envelope
Bidding Procedure

Issued on:	**09 May 2025**
Invitation for Bids No.:	**PMD/DLSD/ETDSP/DRCP-081/82-01**
OCB No.:	**PMD/DLSD/ETDSP/DRCP-081/82-01**
Employer:	**Nepal Electricity Authority**
Country:	**Nepal**

VOLUME –II OF III

Disaster Recovery Centre Project
Distribution Line and Substation Department
Project Management Directorate
Matatirtha, Kathmandu, Nepal

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Volume-II

Project Specific Requirement (PSR)

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1. Background

The Nepal Electricity Authority (NEA) is a comprehensive power generation, transmission, and distribution organization that provides electricity services throughout Nepal. Established on August 16, 1985, under the Nepal Electricity Authority Act of 1984, NEA was formed through the merger of the Department of Electricity, the Ministry of Water Resources, the Nepal Electricity Corporation, and various development boards.

NEA's primary objective is to generate, transmit, and distribute adequate, reliable, and affordable power. This involves planning, constructing, operating, and maintaining all generation, transmission, and distribution facilities within Nepal's interconnected and isolated power systems. In addition to this core mission, NEA has several key responsibilities:

a) To advise the Government of Nepal on long- and short-term plans and policies related to the power sector.
b) To recommend, determine, and implement the tariff structure for electricity consumption, subject to prior approval by the Government of Nepal.
c) To facilitate capacity building to develop skilled manpower in generation, transmission, distribution, and other related sectors.

Nepal Electricity Authority is intending to construct Disaster Recovery Centre (DRC) at the premise of New-Butwal Substation at Bhumahi, Nawalparasi district of Nepal. It is also intended to establish cloud infrastructure at the existing Data Centre (DC) of NEA and establishing a dual-path DC-DRC connection utilizing a DWDM network and integrating cloud infrastructure for both the Data Centre (DC) and Disaster Recovery (DR) Centre.

The project for construction of DRC is being funded by ADB under of SASEC-Electricity Transmission and Distribution Strengthening Project (SASEC-ETDSP).

This specification describes the requirements for construction of DRC and associated facilities on a turnkey basis.

1.1 Current Status

NEA Data Centre

NEA has successfully constructed its own data center on the premises of the Syuchatar substation. This Tier III standard containerized data center, manufactured by Huawei in China, features a total of 24 assembled containers. A three-story building is constructed before 2 years: the ground floor will house the DCC, the first floor will be designated for office use, and the top floor will serve as the data center.

The fully automated data center is equipped with 36 server racks and 4 network racks. It includes a dual power system featuring a Dedicated Transformer (DTR), Diesel Generator (DG), and Uninterruptible Power Supply (UPS). Additional facilities include HVAC systems, a firefighting system, a water leakage detection system, Building Management System (BMS), Network Operations Center (NOC), and Security Operations Center (SOC), water sprinkling system, CCTV surveillance, rodent repellent system, and access control measures, ensuring a comprehensive and secure operational environment.

DCC/DMS/OMS

To enhance its distribution network management, NEA has implemented a smart metering system for approximately 340,000 consumers across Nepal, with plans to extend this smart metering infrastructure to all 6 million consumers nationwide. Additionally, NEA has initiated underground power cable projects, along with communication infrastructure for the distribution network below the 11kV supply level in Kathmandu Valley, Pokhara, and Bharatpur.

This connectivity infrastructure will bolster the Distribution Control Center (DCC) and data center projects, which are nearing completion and based in the Kathmandu Valley. The DCC project aims to improve distribution planning and coordination through the implementation of SCADA, DMS, and OMS across the Kathmandu Valley. Furthermore, the Substation Automation System (SAS) is already operational for 9 substations within Kathmandu Valley, with additional substations outside the valley currently in the bidder selection process.

In conjunction with distribution system reinforcement projects in the Kathmandu Valley and the implementation of a substation automation system, NEA has initiated the rollout of a Distribution Management System (DMS) and an Outage Management System (OMS) utilizing SCADA technology from the DCC building. All feeders will be linked to substations within the Kathmandu Valley via OPFC/GPRS, which will connect these substations to the DCC.

The OPFC/GPRS will also facilitate connections between all RMUs, transformers, and other intelligent devices such as RTUs and FRTUs to the SCADA control system. These distribution system reinforcement projects will establish a ring network, significantly reducing the likelihood of supply failures.

GIS, ERP and RMS

NEA is also pursuing various technology initiatives, including a Revenue Management System (RMS) for 7 million consumers, an Enterprise Resource Planning (ERP) system (which is in the stage of bid preparation), and Geographic Information Systems (GIS), with plans to introduce further technological advancements in the near future. These initiatives underscore the need for a robust business continuity and communication infrastructure, enabling NEA to efficiently serve both its consumers and employees.

The All-Nepal GIS project is currently underway, with NEA preparing bid documents under the Distribution and Consumer Services Directorate (DCSD) and Technical Services Department. Enterprise Resource Planning (ERP) system is set to be implemented, featuring over 12 modules, and is now in the bid preparation phase as part of the Institutional Strengthening Project (ISP).

Furthermore, NEA is implementing a new Revenue Management System (RMS), which will replace the old M-Power Billing System across all 129 DCS and 157 revenue collection centers throughout Nepal.

Online meter reading, Any Branch Payment System (ABPS) and online collection system

NEA has initiated online meter reading using handheld devices that operate via GPRS and Wi-Fi networks. These devices efficiently transmit meter reading data to the central server, allowing collection counters to easily download and update readings.

Additionally, NEA has implemented any branch payment system in the Kathmandu Valley and established VPN counters in approximately 80 DCS offices nationwide. Since 2074 BS, an online payment system has been made available at all revenue collection centers, enabling consumers to pay their bills through various banks, money transfer services, and wallet service providers.

1.2 Other IT Applications

The Information Technology Department is responsible for delivering essential IT-related services within the organization. It plays a crucial role in driving digital transformation and enhancing operational efficiencies. Here are some key aspects and initiatives that illustrate its impact:

a. Digital Transformation and Automation:

The Information Technology Department is dedicated to leveraging Information Technology (IT) and Operational Technology (OT) to minimize redundancies, reduce errors, and enhance workflows across NEA.

The department prioritizes the implementation of innovative Information and Communication Technology (ICT) systems, ensuring continuous support and training for all NEA offices. This commitment fosters a more efficient and effective operational environment.

b. NEA ITS Policy (2023):

NEA's IT Policy covers a comprehensive range of areas, including the use of Information and Communication Technologies, safety and security protocols, business operations management, IT procurement, asset management, and safety management. By harnessing the potential of technology across these domains, NEA can significantly enhance operational efficiency, streamline processes, and improve overall service delivery.

The policy establishes an IT Management Committee that plays a crucial role in evaluating new technologies, assessing their necessity, and analyzing their potential impact on NEA's operations. This committee also ensures regular updates to the policy, which helps mitigate risks, strengthen cyber resilience, and address any necessary exemptions.

Ongoing updates are essential for maintaining compliance with evolving IT standards and bolstering NEA's cyber security posture.

c. Enhanced Customer Interaction:

The upgraded NEA Mobile App and CRM software now include features such as monthly bill checking, seamless payment options, a fault information system, and a comprehensive complaint management system. These enhancements significantly improve customer service and engagement. Additionally, NEA has established call centres in all provincial and divisional offices to further enhance customer support.

d. Operational Efficiency and Management:

NEA has introduced online applications for new connections and established a centralized call center (hotline 1150) to streamline consumer-related operations. The Vehicle Management Information System, integrated with GPS, improves transparency and operational efficiency.

Upgrades to various software applications, including the Customized Accounting System (CAS), a centralized E-Attendance System, and a Central Payroll and Pension Management System, are going on. These enhancements aim to improve functionality, security and user satisfaction while ensuring seamless integration with minimal disruption to business operations.

Additionally, a small Private Cloud has been implemented for employees, offering enhanced security, control, and customization within their cloud computing environment.

e. Infrastructure and Security Enhancements:

The implementation of Software-Defined Wide Area Network (SD-WAN) and plans for SD-Branch/LAN that significantly enhance network security and improve operational efficiency. Additionally, access point devices with a broad transmission range have been deployed to meet the diverse connectivity needs across NEA premises.

f. Data Centre:

NEA has established its own data center, which is essential for ensuring the availability, reliability, and security of digital services and information. The organization also plans to extend its communication network backbone nationwide through the SCADA project, further enhancing centralized access to information.

The Near Line Data Center at NEA Head Office is equipped with Precision Air Conditioners (PAC) and backup generators to ensure operational continuity and protect equipment integrity.

g. Cyber security Measures:

As NEA enhances its digital connectivity, it faces increased vulnerabilities related to cyber security. Recognizing the importance of protecting critical infrastructure, NEA has proactively invested in cyber security measures and established effective guidelines to safeguard these essential systems.

Key initiatives include the implementation of robust firewalls, intrusion detection systems, Web Application Firewalls (WAF), Distributed Denial of Service (DDoS) protection, Network Detection and Response (NDR) systems, and Security Information and Event Management (SIEM/SOAR) systems. Continuous monitoring protocols have also been prioritized to strengthen NEA's digital assets and proactively mitigate potential cyber threats.

Additionally, Privileged Access Management (PAM) will be implemented to develop cyber security strategies and technologies that secure, manage, and monitor privileged access within NEA's IT environment.

h. Future Initiatives:

The collaboration for operating the data center at Syuchatar aims to generate revenue by leasing bandwidth and data space to government offices and private organizations. Guided by the IT Policy 2023, NEA is committed to leveraging Information Technology to modernize its processes and deliver reliable, clean electricity services to consumers. By embracing ICT, ensuring safety and security, optimizing business operations, and adopting best practices in procurement and asset management, NEA is paving the way for a more efficient, resilient, and sustainable power sector.

Key initiatives include:

- **Centralization of Payroll and Pension Management:** The payroll and pension management information system, previously operating in a decentralized manner across more than 200 NEA offices, is now being centralized.
- **Centralization of Accounting Information System:** The Accounting Information System (CAIS), which was decentralized across over 492 NEA offices, is also being centralized.
- **Centralized Employee E-Attendance System:** An e-attendance system is being implemented nationwide to streamline attendance management.
- **Centralized Fixed Asset and Inventory Management Systems:** Both systems are now being managed centrally to enhance efficiency.

- **NEA Mobile App Implementation:** The IT department is rolling out the NEA mobile app in the fiscal year 2079/80 BS.
- **Online Meter Applications and Complaint Management Systems:** These systems have been developed and implemented across all provincial and division offices, along with their respective branches.
- **E-Bidding Process:** NEA management has decided to process e-bidding through the government portal www.bolpatra.gov.np, facilitated by the Public Procurement Monitoring Office (PPMO) since Shrawan 2075 BS.
- **SCADA EMS Solution Upgrade:** The upgrade of the existing SCADA Energy Management System has been completed by M/s Siemens.
- **Any Branch Payment System Rollout:** The implementation of any branch payment system is underway to enhance service delivery throughout the country.

These initiatives reflect NEA's commitment to innovation and operational excellence in the power sector.

2. Detailed Scope and Intent of Specification:

The project scope encompasses the design, supply, construction, installation, testing, commissioning, operation, and maintenance of civil infrastructure and non-IT infrastructure at the Disaster Recovery Centre. The scope also includes establishing a dual-path DC-DRC connection utilizing a DWDM network and integrating cloud infrastructure for both the Data Centre (DC) and Disaster Recovery Centre (DRC).

The scope of work shall include, in complete conformity with subsequent sections of the specifications, site survey, planning, design, engineering, manufacturing, pre-dispatch Factory Acceptance Test, supply, transportation & insurance, delivery at site, unloading, handling, storage, installation, integration, configuration, testing, commissioning, and demonstration for acceptance, training, operation, maintenance and documentation of the following:

- The employer intends to construct Disaster Recovery Centre (DRC) at NEA owned substation complex at New Butwal Substation, Bhumahi, Nawalparasi District of Nepal.
- Survey, soil test, Design layout etc. of civil and non- IT infrastructure of DRC.
- Communication network establishment between Data Centre (KTM) to DRC (Butwal) site using DWDM technology. NEA shall provide 2 core optical fiber but all other necessary DWDM equipment, amps, patch cables and related accessories shall be provided by the bidder.
- Baseline parameters/KPIs proposed for improvement and monitoring.
- Procurement of necessary technology, equipment, and services for the project.
- Supply, installation and commissioning of necessary infrastructure and hardware at Disaster Recovery Centre (DRC).
- The SI shall be responsible for the testing processes such as planning (includes preparing test plans and defining roles and their responsibilities), preparation (consists of preparing test specification, test environment and test data) for all tests viz. type tests, FAT, SAT and successful commissioning.
- The SI shall do the necessary study of existing system, equipment, redundant fibre networks and submit the detail network diagram, network costing and report to NEA.
- Construction of the NEA disaster recovery Centre building that shall house the Disaster Recovery Centre (DRC), Network Operating Centre (NOC) and Building Management System (BMS) as desired by NEA.

- Specialized and basic training to the employees of the NEA pertaining to their areas of work inside and outside Nepal.
- O&M including supply of manpower for DRC, NOC, BMS, Civil Builds, facility management and non-Support for a period of 3 years from Go-Live.
- Annual maintenance contract services for DRC, NOC, BMS and Civil Build, non-IT infrastructure, Optical fibre communication system using DWDM technology and Cloud infrastructure in DC and DR including cloud software for 3 years from Go-Live.
- The scope also includes, but not limited to the following services/items described herein and elsewhere in specification:
- **Project management and site supervision:** The System Integrator (SI) shall be responsible for the overall management and supervision of works, including the implementation of risk management as well as change management initiatives. He/she or SI shall provide experienced, skilled, knowledgeable and competent personnel for all phases of the project, to provide the utility with a high-quality system. Proposed project manager should be fluent in English language and cooperative.
- **Interface coordination:** The bidder shall identify all interface issues with utility and other agencies if any, and inform utility which shall interface, coordinate and exchange all necessary information among all concerned agencies.
- Any item though not specifically mentioned but is required to complete the project works in all respects for its safe, reliable, efficient and trouble-free operation &to meet performance, availability & functional requirements as envisaged in the RFP shall also be taken to be included, and the same shall be supplied and installed by the SI without any extra cost.
- All civil & architectural works, internal and external electrification, special electronic earthing for server and network racks, air conditioning and ventilation, fire detection system and fire fighting system and access control system required for DRC, NOC are in the scope of SI, however contractor has to indicate the space requirement for DRC, NOC ,auxiliary power supply & communication equipment any other specific requirement, power supply requirement including standby supply requirement, so that the utility can provide the same as per bidder's requirement.
- Communication between Data Centre (DC) & Disaster Recovery Centre (DRC) ensuring high-capacity, low-latency, and secure data transmission. Key activities including conducting site surveys, fibre optic cables maintenance, setting up DWDM or OTN equipment & communication including thorough testing to ensure data integrity and availability of DCI solution.
- Supply, Delivery, Installation and Integrating proposed NEA Private Cloud with existing systems (like Private Cloud operating in NEA existing Data Centre with the Virtual Machines and others), setting up secure access controls, efficient and reliable Disaster Recovery Centre (DRC) operations and NEA Private Cloud supply deployment and maintaining operations including thorough testing to ensure data integrity and availability on Private Cloud.
- SI shall submit DR management plan and get it approved from the Employer. SI should perform minimum one DR drill every year to check the sustainability between DC & DR.
- All the equipment (including power, cooling, system, networking, racks, power distribution points, emergency points and any other accessories etc.) computers and cabling inside the DRC building will be responsibility of Bidder.
- During the design approval, bidder has to provide the list of critical and non-critical load.
- Seating plan inside the DRC building has to be submitted by the bidder (as per described areas in the RFP) as a part of the Design Document. The same shall be approved by NEA and based on that final Electrical and cooling solution calculations will be submitted by bidder for final approval.

- Bidder shall also develop the green area in the surroundings of the DRC Building and along with the plantation and beautification.
- Bidder shall submit all relevant calculations and base of assumptions for each proposed component specified in the RFP during submission of the proposal. Further design discussions & enhancements will be carried out with successful bidder.
- The bidder shall ensure that all the solutions proposed in the RFP are based on digital technology as analog-based solutions will not be considered.
- SI shall build a temporary labor camp, water supply, proper sanitation and toilets during the construction work which will be dismantled after completion of the work.
- SI shall conduct abroad training to the owner's employees as described in BOQ. All the expenses including training cost, airfare, hotel accommodation, food and incidental allowances (USD 150 per person per day) etc. shall be provided by the SI and has to include in proposed financial bid proposal.
- SI shall conduct local training in Nepal and all the training cost including trainer's charge, accommodation, and lunch for the trainees, training venue etc. has to be provided by SI and has to include in proposed financial bid proposal.

Note:

- Any minor electrical/ communication equipment/items which are not mentioned in the bidding documents but are required for the successful completion of the project shall be in the scope of contractor for which no extra payment will be made and deemed to be included in the current price schedule.
- Any damages to the existing facilities of NEA and other utilities incurred by the Contractor during the construction process shall be borne by the contractor.

2.1 Additional information:

2.1.1 The DRC building is intended to be prefabricated modular (container type) structured 2 storeyed building, to house the DRC, office area, NOC and infrastructure for Disaster Recovery Centre (DRC). The design shall be such that it can be scaled to 3 storied building and no infrastructures shall be mounted at the top of the building.

2.1.2 The DRC building is required to be constructed as per implementation project plan from contract effective date.

2.1.3 All the equipment including communication system, required for the successful operation of the system is in the scope. The cost for such supply and installation shall be included in the respective cost.
The bidder is required to provide the cost breakdown for all items to be supplied for integration work, as required. The site visit and study of existing system, scope of the contract of other projects related with this project shall be done to access the equipment to be supplied and installed. The items required to be quoted separately includes the communication switches, modules, FoDPs etc.

2.1.4 ***Civil Works*** *- The scope of work shall include but shall not be limited to the following based on design and drawings to be developed by the contractor: - (where applicable as per the BPS)*

a) The DRC building is intended to be Prefabricated Modular (container type) structured 2 storied building (scalable to 3 stories building), to house the DRC, office area, NOC and infrastructure for Disaster Recovery Centre (DRC).

b) All civil works including foundations associated with DRC building, Diesel generators, transformers etc.

c) Cable trenches, duct way etc inside and outside DRC buildings.

d) Foundations of generators, along with jacking pad and pylon supports, exhaust systems and other required.

e) Boundary wall, main gate, guard house, compound drainage

f) Any Civil infrastructures for adaptation of existing pump house necessary for the proper water supply in the DRC building for requirements for fire fighting system, sanitation etc.

g) Separate drainage system to be installed to ensure no water blockage at the roof of the DRC building.

h) **Soil investigation:** The contractor is required to perform the soil investigation. The cost for such test shall be included in the respective item in price schedule.

i) Any other item/design/drawing for completion of scope of work.

The bidders are advised to visit the disaster recovery project sites and acquaint themselves with the topography, infrastructure and also the design philosophy.

Though the Employer shall endeavor to provide the information, it shall not be binding for the Employer to provide the same. The bidder shall be fully responsible for providing all equipment, materials, system and services specified or otherwise which are required to complete the construction and successful commissioning, operation & maintenance of the system in all respects. All materials required for the Civil and construction / installation work shall be supplied by the Contractor. The cement (asbestos free) and steel shall also be supplied by the Contractor.

The complete design **(unless specified otherwise in specification elsewhere)** and detailed engineering shall be done by the Contractor based on conceptual tender drawings. Drawings for civil works enclosed with tender drawings are for information only. However civil drawings shall be developed by the contractor as per his design.

2.2 The Contractor shall also be responsible for the overall co-ordination with internal / external agencies, project management, training of Employer's manpower, loading, unloading, handling, moving to destination for successful erection, testing and commissioning of the disaster recovery Centre.

2.3 Final Checking, Testing and commissioning

2.3.1 Erection, testing and commissioning of DRC facilities (including Diesel Generator and Cooling system), Cloud infrastructure including all hardware and software and DWDM

infrastructure shall be done under the supervision of respective equipment manufacturers. Charges for the above supervision shall be included by the bidder in the respective equipment in BPS in volume III.

2.3.2 After completion of Works, final checking shall be done by the Contractor to ensure that all Works, equipment erection etc. has been done according to specifications and as approved by the Employer.

3. Contract Execution Procedure

The contractor **must** submit a detailed project plan, outlining the timeline, resources, and methodologies to be deployed. Following approval of the project plan, the design phase commences, involving the creation of detailed architectural and engineering designs, which must be reviewed and approved by the client. SI shall start the procurement of the necessary hardware and software components after obtaining the approval of designs by the client. SI shall submit all the design documents according to the project plan. Ensuring all supplies meet the specified technical requirements. During the installation phase, SI shall set up all the components of the project according to the approved designs. Throughout this phase, thorough testing shall be conducted to ensure functionality and compliance with project specifications. Subsequently, the commissioning phase involves the integration and testing of the entire system to verify operational readiness. This includes the configuration of the disaster recovery Centre, private cloud setup, and ensuring robust communication infrastructure for the data Centre and disaster recovery Centre as per the project plan timelines. Regularly, comprehensive trainings during installation, commissioning and UAT phases for client personals should be provided to ensure effective management and operation of the newly installed systems. The project shall be ends up with a final review and acceptance by the client, ensuring all contractual obligations have been met satisfactorily.

4. Specific Exclusions: (Not Applicable)

- Maintaining dust free environment and protection from rodents and vermin is the responsibility of Utility.
- Regular cleaning of computer furniture and surroundings is the responsibility of utility.
- Equipment shutdown during preventive maintenance shall be deemed as available.

5. Physical and other Parameters

5.1 Location of the Project Site: New Butwal Substation, Bhumahi, Nawalparasi, Nepal.

5.2 Meteorological data:

a) Altitude above sea level: 115 m

b) Ambient Air Temperature: 10 ºC (minimum) to 45ºC (maximum)

c) Average Humidity (in %): 90 (maximum), 60 (minimum)

d) The project locations are lying in the Wind Speed Zone 4.

e) Seismic Requirement for equipment's: 0.5 g (Horizontal5 peak acceleration value).
Seismic Requirement for Design and construction of Civil Structure: 0.5g (Horizontal Peak acceleration value)

The contractor shall provide the justification for use of above values during detailed design and engineering (DDE).

However, for design purposes, ambient temperature should be considered as 50 degree centigrade and Relative humidity 100%. Altitude (from MSL) to be considered as 115 meters.

6. Schedule of Quantities

The requirement of various items/equipment and works are indicated in Bid price Schedules. Wherever the quantities of items/works are indicated as a Lot, the bidder is required to quote price for entire execution and completion of works.

For erection hardware items, Bidders shall estimate the total requirement of the works and include the same in relevant Bid price schedules.

Bidder should include all such items in the bid proposal sheets, which are not specifically mentioned but are essential for the execution of the contract. Items which explicitly may not appear in various schedules and required for successful commissioning of this project (complete scope of work) **shall be included in the bid price and shall be provided at no extra cost to Employer**.

7. Reference Drawings

7.1 Basic general drawings are enclosed in the specification documents for reference, which shall be further engineered by the bidder.

7.2 In case of any discrepancy between the drawings and text of specification, the requirements of text shall prevail in general. However, the Bidder is advised to get these clarified from Employer.

Order of Precedence of Different Parts of Technical Specification

For the purpose of present scope of work, technical specification shall consist of following parts, and they should be read in conjunction with each other.

1	Project Specific Requirement	
2	General Requirement	
3	Specifications	

8. Spares

Mandatory spares

The Mandatory Spares shall be included in the bid proposal by the bidder. The prices of these spares shall be given by the Bidder in the relevant schedule of BPS and shall be considered for evaluation of bid. It shall not be binding on the Employer to procure all of these mandatory spares.

The bidder is clarified that no mandatory spares shall be used during the commissioning of the equipment. Any spares required for commissioning purpose shall be arranged by the

Contractor. The unutilized spares if any brought for commissioning purpose shall be taken back by the contractor.

9. Special Tools and Tackles

The bidder shall include in his proposal the deployment of all special tools and tackles required for operation and maintenance of equipment. The special tools and tackles shall only cover items which are specifically required for the equipment offered and are proprietary in nature. However, a list of all such devices should be indicated in the relevant schedule provided in the BPS. In addition to this the Contractor shall also furnish a list of special tools and tackles for the various equipment in a manner to be referred by the Employer during the operation of these equipment. The scope of special tools and tackles are to be decided during detail engineering and the list of special tools and tackles, if any shall be finalized**.**

10. Facilities to be provided by the Owner

The Employer may provide the auxiliary power supply from NEA on chargeable basis as temporary consumer. The prevailing energy rates shall be applicable. All further distribution from the same for construction and permanent auxiliary supply shall be made by the contractor. However, in case of failure of power due to any unavoidable circumstances, the contractor shall make his own necessary arrangements like diesel generator sets etc. at his own cost so that progress of work is not affected, and Owner shall in no case be responsible for any delay in works because of non-availability of power.

11. Specific Requirement

The Bidders are advised to visit project site and acquaint themselves with the topography, infrastructure, etc.

The bidder shall be responsible for safety of human and equipment during the working. It will be the responsibility of the Contractor to co-ordinate and obtain Electrical clearance from NEA before commissioning. Any additional items, modification due to observation of such statutory authorities shall be provided by the Contractor at no extra cost to the Employer.

The Contractor shall arrange all T&P (such as necessary supports, cranes, ladders, platforms etc.) for erection, testing & commissioning of the system at his own cost. Further, all consumables, wastage and damages shall be to the account of contractor.

The Contractor shall impart the necessary training to Employer's Personnel as mentioned in the RFP.

12. Pre commissioning, commissioning, Trial-Run & Completion

Pre-commissioning phase involves several critical activities to ensure a smooth transition to the subsequent stages: -

A comprehensive project plan, detailed bill of material, detailed procurement plan including the timeline, milestones, resource allocation, and risk management strategies shall be submitted for

approval. If SI shall implement the equipment / solutions without getting approval of the design and the implementation documents no payments will be processed for the solution.
Detailed design documents will be created, covering architectural, structural, electrical, and network designs, the same shall be reviewed and approved by the client.

In the procurement stage, all required hardware, software, and materials will be sourced according to the tender technical specifications without any deviations.

Site preparation is also a crucial part of this phase, involving any necessary construction or modifications to existing infrastructure.
The commissioning phase includes detailed design, procurement, installation, testing, and commissioning of all necessary components. Key deliverables include but are not limited to redundant power supply systems, high-speed communication links, robust network architecture, scalable storage solutions, and comprehensive disaster recovery drills. The selected vendor must demonstrate expertise in deploying secure and resilient IT infrastructure, ensuring seamless integration with existing systems, and providing ongoing support post-implementation.
Trail run activities focus on validating the functionality and readiness of the project under controlled conditions.

Upon completion of the project, several critical activities ensure its readiness and functionality. These include finalizing all installations and configurations of hardware, software, and networking components according to design specifications. Comprehensive testing will be conducted to validate the effectiveness of backup and recovery procedures, ensuring seamless data replication and continuity in case of disruptions. Documentation will be finalized, detailing all configurations, procedures, and test results for future reference and compliance purposes. Training sessions will be provided to staff members and relevant stakeholders on operating procedures.

13. Social Safeguard and Environment and Management Plan

The Contractor is required to follow Environment Management Plan (EMP) prepared for the execution of this project which is attached in the Appendix-IV. The cost required for activities mentioned under EMP shall be included in the respective applicable items of price schedule of the bid document.

The Contractor shall also prepare its own detailed Social Safeguard and Environment Management Plan to be implemented during execution of the Project. The following major activities shall be considered:

Labour recruitment: The Contractor shall give preference to the use of local and regional labour provided that it is consistent with the requirement of good workmanship based on the need of the project.

Staff training and sensitization: At the beginning of works the Contractor shall organize training and awareness-raising workshops intended for his teams to improve their understanding to prevent or minimize the impact of their activities on the environmental and social aspects to promote good relations with the local people.

Among other topics addressed should also include the following:

Likely environmental impact of works, good practices, preventive and corrective measures to be adopted; Rules and procedures for waste management at construction sites; Safety risks associated with the works, and preventive attitude to adopt; First aid and what to do in case of accident; General standards concerning relations with the local people; Risks and prevention of sexually transmitted diseases. The training and awareness sessions should be organized whenever new workers are recruited. Feedback and training during the works and after the monitoring and control exercise, additional training and awareness activities may be necessary if it happens that the previous sessions had failed to achieve the desired effects.

Demarcation, signing and closing of worksites: Setting up warning signs at worksites to limit the access of persons, machinery and equipment into construction areas and confine the works related to the construction process to the allocated areas.

Access to private property: Contractor shall coordinate with the Employer for the access of private property, if required. Crossing of private property shall be subject to prior notification to the owners and conducted in such a manner as to minimize damage to crops or other property on the land.

Discovery of relics of historical and archaeological importance: In the unlikely event of discovery of historical relics, the works will be interrupted temporarily and the discovery notified to the local authority responsible for cultural heritage in order to determine the appropriate course of action.

Restoration of sites: After the infrastructure has been put in place and the construction sites and equipment depots cleared, the sites should be rehabilitated without undue delay in the original condition or better, unless there are plans for future use requiring that such sites be left in their current state.

Storage and handling of hazardous substances: Hazardous substances such as oils, lubricants or other hazardous substances likely to contaminate surface or ground water and soil should be stored or handled in premises specially designed for this purpose, in order to protect the environment and human health. If the handling of oils and fuels is necessary, demarcated and waterproofed areas that may contain any spills must be provided.

Maintenance of equipment: Maintenance of equipment should not be performed immediately at the work site as far as practicable.

Air quality and noise pollution: Care must be taken to ensure that all equipment, machinery and vehicles used for works and equipped with a combustion engine are in good working conditions to limit undesired emission of air pollutants and f nuisance.

Construction works that could cause noise should be performed only outside normal rest hours near residential areas. When noisy works must be carried out close to schools or other noise-sensitive receptors, working hours should be so scheduled as to limit the nuisance caused.
It is forbidden to burn in the open any kind of household, industrial and toxic or hazardous waste, project induced waste and all types of scrap metal.

Transportation of equipment: Equipment for overhead lines will be transported by existing roads up to the point nearest to the installation site. Thereafter, it will be transported manually to the site without opening up any access paths. When crossing the land between roads and installation sites, care should be taken not to damage vegetation, agricultural land or any other property on the land.

Erection of Poles: Vegetation should be removed only in so far as strictly necessary for opening foundations for poles and for such other operations as may be performed at each spot. When erecting the poles, necessary precaution should be taken to minimize the impact on adjacent areas.

Unrolling of cables: When cables are being unrolled, necessary precaution should be taken to prevent impact on tree vegetation, crops and other property on the land crossed by the cables. If necessary, temporary gantry-like structures should be used to facilitate crossings.

Restoration or damage compensation: If the works on private property cause damage to crops or other property, the Contractor must proceed with the repair of such damage or, where this solution is not sustainable, with the fair and timely compensation of the owners.

Management of material from digging trenches: Uncontaminated soil from excavations will be reused to backfill the trenches of underground lines. Any such soil that cannot be reused is deemed to be waste and must be conveyed to its final destination. Its uncontrolled spread is prohibited in places where it could cause damage. Minimum dust on ground policy is to be used to prevent dust associated pollution after the construction.

Sensitive Areas: From an environmental point of view, wetlands, swamps, and bogs should be avoided when planning underground cable as these habitats may suffer severe or even irreparable harm. Also, sensitive water flows and archaeological sites should factor in route planning process.

Disruption of pedestrian and automobile traffic: When trenches are opened along the road, they should be barricaded, fenced off and warning signs placed at the worksites to ensure the safety of pedestrians, motorists and the staff carrying out the works.

There must be continued access to land, and buildings located along trenches through installation of secure and clearly signalled temporary structures. This also applies to trenches that cut across the roadways.
Upon completion of the underground cable installation, the trenches should be resealed and the pavement repaired as soon as possible, to ensure its durability and the absence of irregularities that may present a traffic hazard.

Regular sprinkling of water shall be done to avoid dust pollution till the roads/sidewalks are reinstated.

Public information on electrical hazards, behaviour and preventive measures: Before switching on the infrastructure installed as part of the project, the neighbouring populations

should be informed in good time, through public meetings and/or distribution of information leaflets. The information provided to them should focus on the electrical hazards associated with the infrastructure and the behaviour that would allow them to avert such hazards. The population of these areas should be particularly targeted.

Unanticipated Impacts identified during the construction should be mitigated in coordination with environmental and social monitors employed by Contractor, Consultant and Government separately.

14. Personnel Safety

The maximum safety consistent with good erection practices in the case of work above ground must be afforded to personnel directly engaged under this contract. Reasonable measures shall be taken to afford adequate protection against material falling from a higher level onto personnel below. Requirement for Environmental Health and Safety Management Plan also specified in Vol I under 1.3.6.1 and Section 4 as Environmental Health and Safety Management Requirement.

15. TRAININGS

The Contractor shall impart the necessary training to NEA's Personnel as per following details: -

1. **Training at Manufacturer/ Supplier's works**. The Contractor shall include in the training charges (i) Accommodation Charges (ii) payment of per Diem allowance to NEA trainees @ USD150 per day per trainee for the duration of training period abroad towards meals and other incidental expenses and (iii) to and fro economy class air ticket from Nepal to place of training. The duration of training shall be excluding travelling period. It shall be quoted under Schedule 4(b): Training Charges for training to be imparted abroad.

   The training shall be provided in the field of design, testing and maintenance at Manufacturer's works as per following: -

(a) Design and Testing DC and DRC facilities: 6 Days. (10 Nos. of Trainees or as per BPS)

(b) Operation and Maintenance of DRC: 10 Days. (10 Nos. of Trainees or as per BPS)

(c) Optical Fibre Network and DWDM Technology: 5 Days. (5 Nos. of Trainees or as per BPS)

(d) Cloud Services (Hardware and Software): 10 Days. (10 Nos. Trainees or as per BPS)

2. **On Job Training in Nepal:** The traveling and living expenses of Owner's personnel for the training programme conducted in Nepal shall be borne by the Owner. It shall be quoted under Schedule 4(c): Training Charges imparted to Employer's Personnel by Bidder's Instructor in Nepal.

   The training shall be provided to Employer's personnel in the field of erection, testing, operation and maintenance at substation sites respectively as per following: -

(a) Operation and Maintenance of DRC facilities: 10 Days as per BPS

(b) Operation and Maintenance of Optical Fibre Network and DWDM Technology: 5 days as per BPS
(c) Cloud Services (Hardware and Software): 15 Days as per BPS

16. SERVICE LEVEL AGREEMENT (SLA)

Support services (including Maintenance) for 3 years:

After the successful commissioning of the entire project, the contractor shall provide the support services which shall include maintenance of the system installed under the project for a period of 3 (three) years from the date of issuance of operational acceptance of the project.

The Scope of Work shall include the DC/DRC infrastructure operation and maintenance support to be provided by the Contractor in respect of the system supplied under this project for a period of three years along with Supervision & Operation of the DC/DRC infrastructure along with communication network after the Operational Acceptance of the entire project. However during the execution of the infrastructure work it is expected that certain portion of the work if completed and put to service before the actual completion and commissioning of the entire project, then in that case also the support services including O&M shall be the responsibility of the contractor in accordance with this document, at no additional/ extra cost towards payment of support services (O&M) during this intervening period.

Single window service:

The Contractor shall provide a single window service to maintain SLA and in case of a joint bid only one organization shall be held responsible & accountable for the of the system as per defined SLA.

16.1.1. The bidder shall provide 24x7 support to NEA to comply with SLAs in case of any problem.
16.1.2. It shall be the responsibility of Contractor to resolve any related issues of DC/DRC and OPGW Cable connection system.
16.1.3. The Contractor is required to work with the Employer's technical personnel during whole SLA period. The Contractor shall support and build the capacities of local counterparts in the day- to-day management, operation and maintenance of the network. Contractor shall conduct on the job training for these counterparts to ensure that they are able to maintain and operate the network in a stable and reliable manner in accordance with established Prudent Utility Practices.
16.1.4. The Contractor is required to provide field personnel for support service including Engineers, Supervisors etc. The numbers of field personnel shall be negotiated.

16.2. Scope of work includes but not limited to:

16.2.1. Operation and running of the DC/DRC/OPG Network/Cloud infrastructure etc.

16.2.2. Maintenance and Repair/ replacement of defective equipment under the project.

16.2.3. Predictive and preventive maintenance of the infrastructure.

16.2.4. Additions and deletions after the commissioning of the entire project is a dynamic phenomenon and shall be catered by the contractor. The network analysis with respect to the additions/ deletions in the DWDM network and designing of the network configuration shall also be carried out by the contractor.

16.2.5. Services to bring up any or all DWDM network upon its failure and to restore the functioning of the same etc.

16.2.6. Any future planning, estimation, augmentation and execution work for strengthening of the existing system shall be done by the contractor during the O&M period. Any material required for the above work shall be provided by the contractor on the same rates as per the award of original project.

16.2.7. On the Job Training for NEA's Staffs for operation and maintenance for equipment and system installed under the project.

16.3. The cost for the SLA shall be deemed to be included in the cost of equipment in BPS.

17.0 GUARANTEE/ WARRANTY

The Contractor shall correct, without any delay and at its own expense, at any portion of the Work during defect liability period and extended defect liability period including any required correction in defective design, errors, omissions, or changes in documentation, or by providing a non-defective replacement within 2 hours of notification of the problem.

The costs of replacement shall be at the Contractor's expense and shall include all shipping costs, duties, fees, and taxes, both to and from the Contractor's facility, and the appropriate technical advice and direction for removal of the defect and installation of the corrected Work including On-Site Services as required. In the event the System or any portion thereof, is down, the Contractor will begin the dispatch process of appropriate personnel as specified.

The Contractor's liability shall be limited to adjusting, repairing, or replacing the defective article(s) and providing technical support and direction in the correction of the Work. In case of replacement of the equipment on or after 2 years a new warranty period shall apply, such new warranty period shall expire together with the project completion period/go-live.

If the Contractor shall fail to correct any defect within a reasonable time, Employer shall have the right to employ others to do so. The contractor shall be liable for all costs and expenses thereby incurred by Employer.

The Contractor shall furnish Employer with a Deficiency incident report upon completion of each visit by such Staff and upon resolution of each inquiry.

The Contractor shall provide to Employer, within 15 Days of the end of each calendar quarter, a list and description of all potential or actual problems.

GENERAL TECHNICAL REQUIREMENT

TABLE OF CONTENTS

1. FOREWORD

The provisions under this chapter are intended to supplement general requirements for the materials, equipment and services covered under other chapters of tender documents and is not exclusive.

2. GENERAL REQUIREMENT

2.1 The contractor shall furnish catalogues, engineering data, technical information, design documents, drawings etc., fully in conformity with the technical specification during detailed engineering.

2.2 Equipment furnished shall be complete in every respect with all mountings, fittings, fixtures and standard accessories normally provided with such equipment and/or needed for erection, completion and safe operation of the equipment as required by applicable codes though they may not have been specifically detailed in the Technical Specifications unless included in the list of exclusions. Materials and components not specifically stated in the specification and bid price schedule, but which are necessary for commissioning and satisfactory operation unless specifically excluded shall be deemed to be included in the scope of the specification and shall be supplied without any extra cost. All similar standard components/parts of similar standard equipment provided, shall be interchangeable with one another.

3. STANDARDS

3.1 The works covered by the specification shall be designed, engineered, manufactured, built, tested and commissioned in accordance with the Acts, Rules, Laws and Regulations of Nepal/relevant IEC standard or Acceptable International Standard.

3.2 The equipment to be furnished under this specification shall conform to latest issue with all amendments (as on the date of bid opening) of standard specified under Annexure-A of this chapter, unless specifically mentioned in the specification.

3.3 The Bidder shall note that standards mentioned in the specification are not mutually exclusive or complete in themselves but intended to complement each other.

3.4 The Contractor shall also note that list of standards presented in this specification is not complete. Whenever necessary the list of standards shall be considered in conjunction with specific IEC or equivalent international standard.

3.5 When the specific requirements stipulated in the specifications exceed or differ than those required by the applicable standards, the stipulation of the specification shall take precedence.

4. SERVICES TO BE PERFORMED BY THE EQUIPMENT BEING FURNISHED

4.1 The equipment furnished under this specification shall perform all its functions and operate satisfactorily without showing undue strain etc. under various operating conditions.

4.2 All equipment shall also perform satisfactorily under various other electrical, electromechanical and meteorological conditions of the site of installation.

4.3 All equipment shall be able to withstand all external and internal mechanical, thermal and electromechanical forces due to various factors like wind load, temperature variation, ice & snow, (wherever applicable) short circuit etc for the equipment.

4.4 The bidder shall design terminal connectors of the equipment taking into account various forces that are required to withstand.

5. ENGINEERING DATA AND DRAWINGS

5.1 The list of drawings/documents which are to be submitted to the Employer shall be discussed and finalized by the Employer at the time of award. The Contractor shall necessarily submit all the drawings/ documents unless anything is waived.

5.2 The Contractor shall submit 4 (four) sets of drawings/ design documents /data / detailed bill of quantity and 1 (one) set of test reports for the approval of the Employer. The contractor shall also submit the softcopy of the above documents in addition to hardcopy.

5.3 **Drawings**

5.3.1 All drawings submitted by the Contractor shall be in sufficient detail to indicate the type, size, arrangement, material description, Bill of Materials, weight of each component, break-up for packing and shipment, dimensions, internal & the external connections, fixing arrangement required and any other information specifically requested in the specifications.

5.3.2 Drawings submitted by the Contractor shall be clearly marked with the name of the Employer, the unit designation, the specifications title, the specification number and the name of the Project. Consultant has standardized few drawings/documents of various make including type test reports which can be used for all projects having similar requirements and in such cases no project specific approval (except for list of applicable drawings along with type test reports) is required. However, distribution copies of standard drawings/documents shall be submitted as per provision of the contract. All titles, noting, markings and writings on the drawing shall be in English. All the dimensions should be in SI units.

5.3.3 The review of these data by the Employer will cover only general conformance of the data to the specifications and documents, interfaces with the equipment provided under the

specifications, external connections and of the dimensions. This review by the Employer may not indicate a thorough review of all dimensions, quantities and details of the equipment, materials, any devices or items indicated, or the accuracy of the information submitted. This review and/or approval by the Employer shall not be considered by the Contractor, as limiting any of his responsibilities and liabilities for mistakes and deviations from the requirements, specified under these specifications and documents.

5.4 All manufacturing and fabrication work in connection with the equipment prior to the approval of the drawings shall be at the Contractor's risk. The Contractor may make any changes in the design which are necessary to make the equipment conform to the provisions and intent of the Contract and such changes will again be subject to approval by the Employer. Approval of Contractor's drawing or work by the Employer shall not relieve the contractor of any of his responsibilities and liabilities under the Contract.

5.5 Approval Procedure

The scheduled dates for the submission of the drawings as well as for, any data/information to be furnished by the Employer would be discussed and finalised at the time of award. The following schedule shall be followed generally for approval and for providing final documentation.

i)	Approval/comments/by Employer on initial Submission	As per agreed Schedule	
ii)	Resubmission (whenever required)	Within 3 (three) weeks from date of comments	
iii)	Approval or comments	Within 3 (three) weeks of receipt of resubmission.	
iv)	Furnishing of distribution copies (5 hard copies to the project team and one scanned copy (pdf format) for Corporate Centre)	2 weeks from the date of approval	
v)		Furnishing of distribution copies of test reports	
(a)		Test reports (one scanned softcopy in pdf format and one hard copy for each transformers, RMU, DG Set, UPS and other equipment's test records)	2 weeks from the date of final approval
(b)		Routine Test Reports (two copy for each equipment)	-do-
vi)	Furnishing of instruction/ operation manuals (4 hard copies to project team and one softcopy (pdf format) for corporate centre)		As per agreed schedule

(vii)	As built drawings (4 hard copies to the project team and one scanned copy (pdf format) for Corporate Centre)	On completion of entire works

NOTE:

1. The contractor may please note that all resubmissions must incorporate all comments given in the earlier submission by the Employer or adequate justification for not incorporating the same must be submitted failing which the submission of documents is likely to be returned.
2. All drawings should be submitted in softcopy form.
3. The instruction Manuals shall contain full details of drawings of all equipment being supplied under this contract, their exploded diagrams with complete instructions for storage, handling, erection, commissioning, testing, operation, trouble shooting, servicing and overhauling procedures.
4. If after the commissioning and initial operation of the project, the instruction manuals require any modifications/ additions/changes, the same shall be incorporated and the updated final instruction manuals shall be submitted by the Contractor to the Employer.
5. The Contractor shall furnish to the Employer catalogues of spare parts.
6. All As-built drawings/documents shall be certified by site indicating the changes before final submission.

6. MATERIAL/ WORKMANSHIP

6.1 General Requirement

6.1.1 Where the specification does not contain references to workmanship, equipment, materials and components of the covered equipment, it is essential that the same must be new, of highest grade of the best quality of their kind, conforming to best engineering practice and suitable for the purpose for which they are intended.

6.1.2 In case where the equipment, materials or components are indicated in the specification as “similar” to any special standard, the Employer shall decide upon the question of similarity. When required by the specification or when required by the Employer the Contractor shall submit, for approval, all the information concerning the materials or components to be used in manufacture. Machinery, equipment, materials and components supplied, installed or used without such approval shall run the risk of subsequent rejection, it being understood that the cost as well as the time delay associated with the rejection shall be borne by the Contractor.

6.1.3 The design of the Works shall be such that installation, future expansions, replacements and general maintenance may be undertaken with a minimum of time and expenses. Each component shall be designed to be consistent with its duty and suitable factors of safety, subject to mutual agreements. All joints and fastenings shall be devised, constructed and

documented so that the component parts shall be accurately positioned and restrained to fulfil their required function. In general, screw threads shall be standard metric threads. The use of other thread forms will only be permitted when prior approval has been obtained from the Employer. All materials and equipment shall be installed in strict accordance with the manufacturer's recommendation(s).

6.2 Degree of Protection

The enclosures of the Control Cabinets, Junction boxes and Marshalling Boxes, panels etc. to be installed shall provide degree of protection as detailed here under:

a) Installed outdoor: IP- 55
b) Installed indoor in air-conditioned area: IP-31
c) Installed in covered area: IP-52
d) Installed indoor in non-air-conditioned area where possibility of entry of water is limited: IP-41.
e) For LT Switchgear (AC & DC distribution Boards): IP-52

The degree of protection shall be in accordance with IEC-60947 (Part-I) / IEC-60529. Type test report for degree of protection test, shall be submitted for approval.

6.3 RATING PLATES, NAME PLATES AND LABELS

6.3.1 Each main and auxiliary item is to have permanently attached to it in a conspicuous Position a rating plate of non-corrosive material upon which is to be engraved manufacturer's name, year of manufacture, equipment name, type or serial number together with details of the loading conditions. The rating plate of each equipment shall be according to IEC requirement.

7. Design Improvements / Coordination

Design improvements and coordination are critical aspects for the successful execution of the project involving the design, supply, installation, and commissioning of a disaster recovery Centre, private cloud, and data Centre communication infrastructure. Meticulous attention to design enhancements should focus on optimizing resilience and scalability. This involves conducting thorough risk assessments to identify potential vulnerabilities and integrating robust security measures to safeguard data integrity. Coordination across all project phases is paramount, ensuring seamless integration of hardware, software, and networking components.

8. QUALITY ASSURANCE PROGRAMME

8.1 To ensure that the equipment and services under the scope of this Contract whether manufactured or performed within the Contractor's Works or at his Sub-contractor's premises or at the Employer's site or at any other place of Work are in accordance with the specifications, the Contractor shall adopt suitable quality assurance programme to control such activities at all points necessary. Such programme shall be broadly outlined by the contractor and finalised after discussions before the award of contract. The detailed programme shall be submitted by the contractor after the award for reference. A quality assurance programme of the contractor shall generally cover the following:

a) His organisation structure for the management and implementation of the proposed quality assurance programme.
b) Documentation control system.
c) Qualification data for bidder's key personnel.
d) The procedure for purchases of materials, parts components and selection of sub-Contractor's services including vendor analysis, source inspection, incoming raw material inspection, verification of material purchases etc.
e) System for shop manufacturing and site erection controls including process controls and fabrication and assembly control.
f) Control of non-conforming items and system for corrective actions.
g) Inspection and test procedure both for manufacture and field activities.
h) Control of calibration and testing of measuring instruments and field activities.
i) System for indication and appraisal of inspection status.
j) System for quality audits.
k) System for authorising release of manufactured product to the Purchaser.
l) System for maintenance of records.
m) System for handling storage and delivery.
n) A quality plan detailing out the specific quality control measures and procedures adopted for controlling the quality characteristics relevant to each item of equipment furnished and/or services rendered.

The Employer or his duly authorised representative reserves the right to carry out quality audit and quality surveillance of the system and procedure of the Contractor/his vendor's quality management and control activities.

8.2 **Quality Assurance Documents**

The contractor would be required to submit all the Quality Assurance Documents as stipulated in the Quality Plan at the time of Employer's inspection of equipment/material.

9. TYPE TESTING, INSPECTION, TESTING & INSPECTION CERTIFICATE

9.1 All equipment being supplied shall conform to type tests as per technical specification and shall be subject to routine tests in accordance with requirements stipulated under respective chapters.

9.2 The reports for all type tests as per technical specification shall be furnished by the Contractor along with equipment / material drawings. The type tests conducted earlier should have either been conducted in accredited laboratory (accredited based on IEC Guide 25 / 17025 or EN 45001 by the national accreditation body of the country where laboratory is located) or witnessed by Utility or representative of accredited test lab or reputed consultant.

The test reports submitted shall be of the tests conducted within last 10 (ten) years prior to the originally Scheduled date of bid opening. In case the test reports are of the test conducted earlier than 10 (ten) years prior to the originally Scheduled date of bid opening, the contractor shall repeat these test(s) at no extra cost to the Employer.

Further, in the event of any discrepancy in the test reports i.e. any test report not acceptable due to any design/manufacturing changes (including substitution of components) or due to non-compliance with the requirement stipulated in the Technical Specification or any/all type tests not carried out, same shall be carried out without any additional cost implication to the Employer.

The Contractor shall intimate the Employer the detailed program about the tests at least two (2) weeks in advance in case of domestic supplies & six (6) weeks in advance in case of foreign supplies.

Further, in case type tests are required to be conducted/repeated and the deputation of Inspector/Employer's representative is required, then all the expenses shall be borne by the Contractor.

9.3 The Employer, his duly authorized representative and/or outside inspection agency acting on behalf of the Employer shall have at all reasonable times free access to the Contractor's/sub-vendors premises or Works and shall have the power at all reasonable times to inspect and examine the materials and workmanship of the Works

during its manufacture or erection if part of the Works is being manufactured or assembled at other premises or works, the Contractor shall obtain for the Engineer and for his duly authorized representative permission to inspect as if the works were manufactured or assembled on the Contractor's own premises or works. Inspection may be made at any stage of manufacture, dispatch or at site at the option of the Employer and the equipment if found unsatisfactory due to bad workmanship or quality, material is liable to be rejected.

9.4 The Contractor shall give the Employer /Inspector fifteen (15) days written notice for on- shore and six (6) weeks' notices for off-shore material being ready for joint testing including contractor and ***Employer.*** Such tests shall be to the Contractor's account except for the expenses of the Inspector. The Employer /inspector, unless witnessing of the tests is virtually waived, will attend such tests within fifteen (15) days of the date of which the equipment is notified as being ready for test/inspection, failing which the Contractor may proceed alone with the test which shall be deemed to have been made in the Inspector's presence and he shall forthwith forward to the Inspector duly certified copies of tests in triplicate.

9.5 The Employer or Inspector shall, within fifteen (15) days from the date of inspection as defined herein give notice in writing to the Contractor, of any objection to any drawings and all or any equipment and workmanship which in his opinion is not in accordance with the Contract. The Contractor shall give due consideration to such objections and shall either make the modifications that may be necessary to meet the said objections or shall confirm in writing to the Employer /Inspector giving reasons therein, that no modifications are necessary to comply with the Contract.

9.6 When the factory tests have been completed at the Contractor's or Sub-Contractor's works, the Employer/inspector shall issue a certificate to this effect within fifteen (15) days after completion of tests but if the tests are not witnessed by the Employer /Inspector, the certificate shall be issued within fifteen (15) days of receipt of the Contractor's Test certificate by the Engineer/Inspector. Failure of the Employer /Inspector to issue such a certificate shall not prevent the Contractor from proceeding with the Works. The completion of these tests or the issue of the certificate shall not bind the Employer to accept the equipment should, it, on further tests after erection, be found not to comply with the Contract. The equipment shall be dispatched to site only after approval of test reports and issuance of CIP by the Employer.

9.7 In all cases where the Contract provides for tests whether at the premises or at the works of the Contractor or of any Sub- Contractor, the Contractor except where otherwise specified shall provide free of charge such items as labour, materials, electricity, fuel, water, stores, apparatus and instruments as may be reasonably demanded by the Employer /Inspector or his authorised representative to carry out effectively such tests of the equipment in accordance with the Contract and shall give facilities to the Employer /Inspector or to his authorised representative to accomplish testing.

9.8 The inspection by Employer and issue of Inspection Certificate thereon shall in no way limit the liabilities and responsibilities of the Contractor in respect of the agreed quality assurance programme forming a part of the Contract.

9.9 The Employer will have the right of having at his own expenses any other test(s) of reasonable nature carried out at Contractor's premises or at site or in any other place in addition of aforesaid type and routine tests, to satisfy that the material complies with the specification.

9.10 The Employer reserves the right for getting any field tests not specified in respective chapters of the technical specification conducted on the completely assembled equipment at site. The testing equipment for these tests shall be provided by the Employer.

10 TESTS

10.1 Pre-commissioning Tests

On completion of erection of the equipment and before charging, each item of the equipment shall be thoroughly cleaned and then inspected jointly by the Employer and the Contractor for correctness and completeness of installation and acceptability for charging, leading to initial pre-commissioning tests at Site. The list of pre-commissioning tests to be performed are given in respective chapters and shall be included in the Contractor's quality assurance programme.

10.2 Commissioning Tests

10.2.1 The available instrumentation and control equipment will to be used during such tests and the Employer will calibrate, all such measuring equipment and devices as far as practicable.

10.2.2 Any special equipment, tools and tackles required for the successful completion of the Commissioning Tests shall be provided by the Contractor, free of cost.

10.2.3 The specific tests requirement on equipment have been brought out in the respective chapters of the technical specification.

10.2.4 The Contractor shall be responsible for obtaining statutory clearances from the concerned authorities for commissioning the equipment and the switchyard, and no extra cost will be provided to the contractor for any permissions or clearances.

11 PACKAGING & PROTECTION

11.1 All the equipment shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at Site till the time of erection. On request of the Employer, the Contractor shall also submit packing details/associated drawing for any equipment/material under his scope of supply, to facilitate the Employer to repack any equipment/material at a later date, in case the need arises. While packing all the materials, the limitation from the point of view of availability of Railway wagon sizes should be taken into account. The Contractor shall be responsible for any loss or damage during transportation, handling and storage due to improper packing. Any demurrage, wharfage and other such charges claimed by the transporters, railways etc. shall be to the account of the Contractor. Employer takes no responsibility of the availability of the wagons.

11.2 All coated surfaces shall be protected against abrasion, impact, discolouration and any other damages. All exposed threaded portions shall be suitably protected with either a metallic or a non-metallic protecting device. All ends of all valves and piping and conduit equipment connections shall be properly sealed with suitable devices to protect them from damage.

12. Finishing of metal surfaces: (blank)

13 HANDLING, STORING AND INSTALLATION

13.1 In accordance with the specific installation instructions as shown on manufacturer's drawings or as directed by the Employer or his representative, the Contractor shall unload, store, erect, install, wire, test and place into commercial use all the equipment included in the contract. Equipment shall be installed in a neat, workmanlike manner so that it is level, plumb, square and properly aligned and oriented.

13.2 The contractor shall have to ensure that the hard and flat indoor and outdoor storage areas are in place prior to commencement of delivery of material at site. Contractor shall also ensure availability of proper unloading and material handling equipment like cranes etc. and polyester/nylon ropes of suitable capacity to avoid damage during unloading and

handling of material at site. All indoor equipment shall be stored indoors. Outdoor equipment may be stored outdoors but on a hard and flat raised area properly covered with waterproof and dustproof covers to protect them from water seepage and moisture ingress. However, all associated control panels, marshalling boxes operating boxes etc. of outdoor equipment are to be stored indoors only.

Storage of equipment on top of another one is not permitted if the wooden packing is used. Material opened for joint inspection shall be repacked properly as per manufacturer's recommendations.

13.3 Contractor shall be responsible for examining all the shipment and notify the Employer immediately of any damage, shortage, discrepancy etc. for the purpose of Employer's information only. The Contractor shall submit to the Employer every week a report detailing all the receipts during the weeks. However, the Contractor shall be solely responsible for any shortages or damages in transit, handling and/or in storage and erection of the equipment at Site. Any demurrage, wharfage and other such charges claimed by the transporters, railways etc. shall be to the account of the Contractor.

13.4 The Contractor shall be fully responsible for the equipment/material until the same is handed over to the Employer in an operating condition after commissioning. Contractor shall be responsible for the maintenance of the equipment/material while in storage as well as after erection until taken over by Employer, as well as protection of the same against theft, element of nature, corrosion, damages etc.

13.5 The Contractor shall be responsible for making suitable indoor storage facilities, to store all equipment which requires indoor storage.

14 TOOLS AND TACKLES

The Contractor shall supply with the equipment one complete set of all special tools and tackles for the erection, assembly, dis- assembly and maintenance of the equipment. However, these tools and tackles shall be separately packed and brought on to Site.

15 AUXILIARY SUPPLY

15.1 The sub-station auxiliary supply is normally met having the following parameters.

Normal Voltage	Variation in Voltage	Frequency in Hz	Phase/Wire	Neutral Connection
400V	±10	50 ±2.5%	3/4 wire	Solidly Earthed
230V	±10	50 ±2.5%	1/2 wire	Solidly Earthed
220V	190 V to 240 V	DC	-	Isolated 2 wire System
110V	95 to 20 V	DC	-	Isolated 2 wire System

48V	-	DC	-	2 Wire System(+) Earthed

Note: Combined variation of voltage and frequency shall be limited to ± 10%.

Technical Specifications - Civil Works & electrical installation works & sanitary water supply work

Table of Content

(CIVIL WORKS REQUIREMENT)
As required and applicable for the project

1.0 GENERAL

Nepal Electricity Authority (NEA) is constructing a Disaster Recovery Centre (DRC) building at the premises of New Butwal Substation, Bhumahi, Nawalparasi Nepal. The DRC building shall house Infrastructure for DC, DRC, NOC and other facilities.

The Contractor shall perform all the works to meet the requirements of these Specifications, the attached drawings and all the relevant Articles in these Contract Documents.

1.1 STANDARD AND REFERENCES

All equipment, materials, fabrication and tests under these Specifications shall conform to the latest applicable standards, manuals and Specifications contained in the following list or, to equivalent applicable standards, manuals and Specifications, established and approved in the country of manufacturer, and approved as equal by Employer.

ACI	American Concrete Institute
AISC	American Institute of Steel Construction
ANSI	American National Standard Institute
ASCE	American Society of Civil Engineers
ASTM	American Society for Testing Materials
AWS	American Welding Society
JIS	Japanese Industrial Standards
DIN	Deutsches Institute fürNormung

Any details not specifically covered by these standards and specifications shall be subject to approval of Employer. In the event of contradictory requirements between the standards and these Specification requirements, the terms of the Specifications shall apply.

Unless specifically mentioned, reference to standards and specifications or to equipment and materials of the particular manufacture shall be considered as followed by "or equivalent". The Contractor may propose equivalent specifications, materials or equipment, which shall be equal in every respect to that specified. If the Contractor, for any reason, proposes equivalents to or deviates from, the above standard, he shall state the exact nature of the change and shall submit complete specifications of the materials, as well as copies of pertinent standards, for the approval of Employer and decision of Employer in the matter of quality shall be final.

1.2 SCOPE OF WORKS (Civil Infra)

The following works shall be carried out to complete the civil and architectural works in all respects, as required for the proper functioning of DRC building:

a. Exploration works for soil strength for foundations of DRC Building. Site Installation Site clearing and stripping for related works.
b. Felling trees including cutting of trunks and branches, removing the roots, stacking serviceable materials and disposal of unserviceable materials to 10m distance and back filling the depressions/pits site grading for related works construction of ECC building as per design and specifications.
c. Supply, Construction and Installation of water supply and sanitary system Supply and installation of Illumination systems.
d. All associated and necessary civil and architectural works to complete the specified scope of work
e. SI shall build a temporary labor camp, water supply, proper sanitation and toilets without any extra cost during the construction work which will be dismantled after completion of the work.

NOTE: This specification shall be read in conjunction with the requirement mentioned in the specification, section A (Specification of civil works) In case of any conflict, better specification and requirement will prevail.

1.3 GENERAL NOTES FOR CONTRACTOR AND DEFINITIONS

I. The work shall be carried out according to the specifications whether specifically mentioned in it or not. No extra in any form shall be paid unless it is definitely stated as an item in the Bill of Quantities. Whenever the specifications are not given or ambiguous, the relevant International Standards and further amendments or decision of the Employer/Engineer shall be considered as final and binding.
II. The work shall be carried out simultaneously with the electrical, plumbing, sanitary and other services and in cooperation with the contractors of the above services. The work shall be carried on till it is completed satisfactorily along with the completion of essential portion of other services. The contractor shall keep the other contractors informed well in advance of the proposed program of the work so that the proposed work is not hindered. The contractor shall further cooperate with other contractors in respect of any facilities required by them e.g. making holes in shuttering for pipes, electric conduits, fan hooks etc. However, nothing extra shall be admissible to him for such reasonable assistance and facilities afforded to other contractors and the contractor shall be deemed to have taken factor into consideration while quoting his rates.

III. The work shall be related to the drawings which the contractor is presumed to have studied. All the engineering construction drawings as required for construction shall be prepared by the Contractor and submitted to the employer for approval. Nothing extra will be paid for preparation of construction drawing and any item because of its shape, location or other difficult circumstances, even if the schedule makes no distinction as long as the item is shown in the drawing.

IV. The source of materials stated in the specifications are those from which materials are generally available. However, materials not conforming to the specifications shall be rejected even if they come from the stated sources. The contractor should satisfy himself that sufficient quantity of material of acceptable specification is available from the stated or other sources.

V. The requirements of specifications for the materials shall be fulfilled by the Contractor without extra charge including transportation or any other taxes involved that is the item rates quoted shall be deemed to have taken these into account.

VI. The bidder should submit detailed structure report with simulation (SAP 2000 / ETABS / STANDPRO)

2.0 GENERAL OFFICIAL ACCESSORIES

2.1 BOARDS

A board of size of 1.5m x 1.0m shall be made and put at an approved place on the site. This board shall be painted in approved colour with names of (a) The proposed construction and owner (b) The Contractor (c any other specialist consultant, as directed by the Employer/ Engineer.

2.2 PREPARING AND CLEARING THE SITE

The site described shall be cleared of all obstructions, structures, building, loose stones and materials, rubbish of all kinds as well as brush-wood. All holes or hollows whether originally existing or produced shall be well rammed and levelled off as directed. The cost for such dismantling of existing structure shall be included in the bid price.

2.3 MEASURING MATERIALS

Materials requiring measuring shall be measured separately in boxes of appropriate sizes before being mixed. They should be calibrated and marked with red, if necessary, in presence of the Employer/Engineer.

2.4 TEMPORARY PROTECTION

All trenches, walls, newly laid concrete or other work requiring protection from weather or accidental injury shall be protected by means of tarpaulin or in any other way so as to keep the work safe. Nothing extra shall be paid for this matter.2.5 QUALITY OF WORK

Materials, tools and plants and workmanship shall be the best of several kinds obtainable in the market and as approved by the Employer/ Engineer.

2.6 LEAVE CLEAN

On completion, all works must be cleaned, rubbish removed, and the works and land cleaned of surplus materials, debris and other accumulations and everything left in clean and orderly condition.

2.7 SAMPLES

Samples of each class of work required shall be submitted by the Contractor for the approval of the Employer/ Engineer and after such approval these samples shall be deposited at a place chosen by the Employer/ Engineer. The Contractor will be required to perform all works under the contract in accordance with these approved samples.

2.8 STORAGE

Safe, dry and proper storage shall be provided for all materials, particularly for cement. The capacity of the cement storage shall be equal to one-fourth of the total quantity to be used but may not exceed 200 tonnes at the site of work.

2.9 SURVEYING EQUIPMENT

The Contractor should supply following surveying instrument if necessary and required for above for checking of contractor's work to the Employer/ Engineer.

a)	Total Station	-	1 set.
b)	Level (Dumpy level)	-	1 set.
c)	Measuring tape (Tazima Standard)	-	2 sets.
d)	Necessary staff and other equipment	-	

The Contractor shall maintain the equipment in a serviceable condition and immediately corrected or replaced if it is found to be inaccurate. The contractor must perform the concrete cube casting and testing in presence of Employer/ Engineer and as directed by him. All casting of testing cubes should be carried out at actual site condition and should be cured according to the main casted slab or beams. The Contractor shall perform tests on materials and concrete cubes as specified as presence of the Employer/ Engineer and as directed by him and shall submit to the Employer/ Engineer two copies of

the results of each test, such results being entered on forms as approved by the Employer/ Engineer. The third copy of the result of each test shall be retained in the Contractor's Laboratory. Without relieving the Contractor any of his responsibilities for the testing of materials the Employer/ Engineer may, as and when desired, carry out any of the tests, using the facilities provided by the Contractor, for this work.

3.0 MATERIALS

3.1 GENERAL

The materials supplied and used in the works shall comply with the requirements of these Specifications. They shall be new, except as may be provided elsewhere in the Contract or permitted by the Employer/ Engineer in writing. The materials shall be manufactured, handled and used in a workmanlike manner to ensure completed work in accordance with the Contract. Where an Indian Standard is specified, the latest version of the standard quoted shall be considered to apply.

3.2 SOURCES

The source of materials should be selected and notified to the Employer/ Engineer and approved by him. The use of any one kind or class of material from more than one source is prohibited, except by written permission of the Employer/ Engineer. Such permission, if granted, will set forth the conditions under which the change may be made. The source or kind of materials shall not be changed at any time without written permission of the Employer/ Engineer. If the product from any source proves unacceptable at any time, the Contractor shall make such arrangements as may be necessary to assure acceptable material, either by alterations in plant operations or by a change of source. Claims for increased costs which may be occasioned by such alterations or changes will not be given consideration, unless the source of the unacceptable material was designated in the Contract as a source of material.

When any manufactured product, either new or used, is furnished by the owner, the location at which such material will be delivered to the Contractor will be designated in the contract. In such cases the contractor shall haul the materials from the designated delivery point to point of use, and compensation for such hauling will be considered to be included in the Contract unit price for placing the materials in the finished work.

3.3 INSPECTION AND ACCEPTANCE OF MATERIALS

Final inspection and acceptance of materials will be made only at the site of the work. The Employer/ Engineer reserves the right to sample, inspect and test materials throughout the duration of the work, and to reject any materials which are found to be unsatisfactory at the time

of use a preliminary inspection of materials may be made at the source for the convenience of the Contractor, but the presence of Employer/ Engineer at the source shall not relieve the Contractor of the responsibility of furnishing materials which comply with these specifications. The Employer/ Engineer shall have free entry at all times to those parts of any plant which concern the manufacture or production of the materials ordered.

3.4 SAMPLES AND TESTS

The Contractor shall submit sample of all materials for the approval of the Employer/ Engineer prior to commencement of work. The Contractor shall give immediate notification of the placing of orders for shipment of materials to permit testing. He shall furnish without charge all samples required and he shall afford such facilities as the Employer/ Engineer requires for collecting and forwarding such samples.

The Contractor shall not make use of or incorporate into the work the materials represented by the samples until the tests have been made and the materials are found to comply with the requirements of the specifications, except that any materials which have a satisfactory record of compliance with the Specifications may, at the discretion of the Employer/ Engineer, be used until the tests are completed. If the material fails to pass the tests, no further use thereof shall be made until the Contractor has taken steps satisfactory to the Employer/ Engineer to correct the deficiencies.

When required by the Employer/ Engineer preliminary samples of the character and quantity prescribed shall be submitted by the Contractor or producer for examination and shall be tested in accordance with the methods referred to in this Specification. The acceptance of a preliminary sample, however, shall not be construed as acceptance of materials from the same source delivered later. Only the materials actually delivered for the work will be considered, and their acceptance or rejection will be based on the results of the tests and inspections prescribed in these Specifications.

3.5 DEFECTIVE MATERIALS

All materials which do not conform to the requirements of the Contract will be rejected whether in place or not. They shall be removed immediately or taken away from the site immediately thereafter. No rejected material, the defects of which have been subsequently corrected, shall be used in the work unless approval in writing has been given by the Employer/ Engineer. Upon failure of the Contractor to comply promptly with any order of the Employer/ Engineer given under this Clause, the Employer/ Engineer shall have authority to cause the removal and replacement of rejected material and to deduct the cost thereof from any monies due to the Contractor.

3.6 FOREIGN MATERIALS

Materials which are manufactured, produced or fabricated outside Nepal shall be delivered to a distribution point in Nepal, unless otherwise required in these specifications or the special provisions, where they shall be retained for a sufficient period of time to permit inspection, sampling, and testing. The Contractor shall not be entitled to an extension of time for acts or events occurring outside Nepal and it shall be the Contractor's responsibility to deliver materials obtained from outside Nepal to the point of entry into Nepal in sufficient time to permit timely delivery to the job site. The Contractor shall provide the facilities and arrange for any testing required at his own cost. All testing by the Contractor shall be subject to witnessing by the Employer/ Engineer. The manufacturer, producer or fabricator of foreign material shall furnish to the Employer/Engineer a "Certificate of Compliance" with the specifications where required. In addition, certified mill test reports clearly identifiable to the lot of material shall be furnished where required in these specifications or otherwise requested by the Employer/ Engineer. Where structural materials requiring mill test reports are obtained from foreign manufacturers, such materials shall be furnished only from those foreign manufacturers who have previously established, to the satisfaction of the Employer/ Engineer, the sufficiency of their in-plant quality control, as deemed necessary by the Employer/ Engineer, to give satisfactory assurance of their ability to furnish material uniformly and consistently in conformance with these specifications. At the option of the Employer/Engineer, such sufficiency shall be established whether by submission of detailed written proof thereof or through in-plant inspection by the Employer/ Engineer.

A. SPECIFICATION OF CIVIL WORKS

A1. EARTHWORK

A1.1. The Contractor must satisfy himself as to the nature of the ground to be excavated. Excavation shall be carried out by the Contractor is such a way as to avoid disturbance to the surrounding ground, to service(s) and roads installed in and that excavations will not cause damage to existing adjacent structures by permitting ground movement.

No heavy plant, hoist or equipment shall be placed adjacent to excavations (or retaining walls) without written permission of the Consultant/Employer. No such permission given or implied shall relieve the Contractor of his responsibilities under the Contract.

Earthwork in excavation in trenches, raft foundation etc. in soil including dressing of sides, ramming of bottom, lift up to 5.00 m (average of the excavated area), stacking of excavation and returning the stacked soil in 150 mm layer when required in plinth, under floors, sides of

foundation, laying and depositing the layer by watering and ramming and then disposing of all surplus excavated soil out of site.

The Contractor shall be responsible for upholding the sides of all excavations by all necessary staging, sheeting and shoring, forms, shuttering, supports and the like. Nothing extra on this account shall be admissible unless taken separately in the Bill of Quantities.

The sand layer found during excavation will not be used by the Contractor for the construction & will be dumped in the specified area approved by the Consultant/Employer. In case of the sand of the suitable quality for construction is found, the Contractor will be allowed to use the sand on mutually agreed cost. The Consultant shall determine the suitability of such sand.

The foundation / raft etc. shall be dug to the dimensions shown on the drawings or to a depth at which in the opinion of the Consultant/Employer a stratum of good hard soil is met with.

The excavation shall be carefully dug out to the levels, shapes and dimensions shown or figured on the drawings or as directed by the Consultant/Employer to receive the footing work. Any of the excess excavation shall be filled, at his own expenses, with concrete of approved grade well rammed in position until it is brought to the proper levels. Filling in with excavated materials will not be allowed. The Contractor, at his own cost, shall dispose of all surplus excavated soil as directed by the Consultant/Employer out of the site without any additional cost to the Employer. If foundations are made broader or longer than directed, the extra length and breadth shall be filled in after the footings are built with earth rammed hard, by the Contractor at his own cost. The Contractor shall at his own cost, expense and without extra charge, make provision for all extra excavation in slope, pumping, dredging or bailing out water and these trenches shall be kept free from water while the footing work is in progress. Nothing extra shall be admissible for pumping and / or bailing out water unless otherwise taken separately in the Bill of Quantities. The Consultant shall inspect the trenches / rafts before the footing work is laid therein, when the trench level shall be recorded. The filling in of the sides of trench excavation shall be done in not more than 150 mm layers. Each layer shall be watered and rammed hard before adding the next layer. Such fillings shall be brought up to the ground level without extra charge and shall form part of the items of excavation / earthworks.

A1.2. Timbering of Foundation

When foundations are to be taken deep, the sides of the trenches shall be protected by erecting timber shoring and strutting. Timbering shall be close or open depending on the nature of the soil and work. The arrangement of timbering sizes and spacing of member shall be as directed by the Consultant.

A1.3. Trimming and Levelling

The bottom of all foundation should be trimmed and levelled in accordance with the drawings. Bottom of foundation shall be rammed and watered before concrete or other footings are constructed.

A1.4. Classification of Soil

Unless hard rock or earth with 50% or more stone or old masonry or concrete or block kanker are met with which require special treatment for the purpose of excavation, it shall be deemed to be excavation in soil, Ordinary pebbles, cobbles or kanker shall be taken under soil for which nothing extra shall be paid.

A1.5. Disposal

Disposal of surplus earth shall be done outside the site as directed by the Consultant.
Nothing extra shall be paid for such disposal.

A1.6. Extra for Lift

Extra payment shall be made for the extra lift involved beyond the depth mentioned above under this item as approved by the Consultant in consultation with the Employer.

A2. CONCRETE WORK

A2.1. Materials

Cement, Sand, Stone aggregate shall conform to the Specifications as under Reinforced Cement Concrete works.

A2.2. Mixing

All proportions shall be by volume except cement, which shall be proportioned by weight and as, specified. Mixing shall be done in a mechanical mixer as per specification of reinforced cement concrete work. However, in special cases, the Consultant may allow hand mixing when the following procedure shall be adopted. The material shall be accurately gauged in boxes and thoroughly mixed until the colour is uniform and then twice wet. Water shall be added gradually and use more than necessary to sufficiently wet the materials. Only that much concrete shall be mixed which can be used within half an hour. Each stack shall however be no larger than consuming one bag of cement. All such stacks shall be placed distant from each other. In case, hand mixing is allowed, the Contractor shall put in 10% more cement than specified without extra charges.

A2.3. Laying

Concrete shall be laid in horizontal layer of not more than 150 mm thick and gently vibrated.

A2.4. Curing

After laying the concrete shall be kept wet for seven days. If cast in hot weather it shall be covered with gunny bags, which shall be kept constantly wet. Other work in concrete shall not start until 3 days after laying of concrete.

A2.5. General RCC Works

All RCC work shall be carried out in strict accordance with and as specified IS 456– 2000, and the working drawings. Any discrepancies in the dimensions on the drawings or any points not clear to the Contractor shall be brought to the notice of the Consultant/Employer and clarified in advance before proceeding with the work.

The Contractor shall allow for all material and if required produce manufacturer's certificates for cement and steel unless waived by the Employer.

No concrete work shall be cast in the absence of the Consultant's representative. The Contractor's Engineer shall personally check that both the formwork and reinforcement have been correctly placed. The Contractor shall make request for inspection of formwork & reinforcement separately to the Consultant at least 48 hours prior to the actual concreting work and get approval in writing for concreting works.

The Contractor shall keep the record of such concreting works (pour card) and shall be made available to the Consultant/Employer whenever required to do so.

A2.6. Materials

The material used in the works shall be of the qualities and kind specified, Materials delivered to the works shall be equal to the approved sample, which shall be deposited with the Consultant/Employer least 30 days before it is required for use in work. Delivery shall be made sufficiently in advanced of constructional requirements to enable further samples to be selected and tested if so desired by the Consultant. No materials shall be used in the works until approved. Materials failing to comply with the approved samples and Specification shall be immediately removed from the works at the Contractor's Cost.

A2.7. Water

Water used in mixing concrete shall be free from injurious amounts of oils, acids, alkalis, organic materials other deleterious substances.

The water used shall conform to IS 456 -2000.

Mixing of water for each batch shall be measured, either by mass or by volume to an accuracy of within 3 percent.

A2.8. Cement

The cement shall be ordinary Portland cement of Grade 43 (Conforming to latest version of IS 8112) of approved brand and manufacturer and shall comply in all respects with an unbroken seal fixed by the makers and plainly marked with the name of brand and date of manufacture. It shall be stored in a dry place, in regular piles not exceeding ten bags high and in such a manner that it will be efficiently protected from moisture and contamination, and that the consignments can be used up in the order in which they are received. Set cement shall be removed from the work and replaced by the Contractor at his own expense. If desired, tests shall be made by taking sample of cement from stores or elsewhere from the works. The selection of samples and procedure for testing shall comply with appropriate IS.

A2.9. Aggregate

All aggregate shall conform to IS 383 - 1970 or its latest revisions. Aggregate shall, where possible, be derived from a source that normally produces aggregate satisfactory for concrete, and if requested by the Consultant/Employer, the Contractor shall supply evidence to this effect. If he is instructed to do so, the Contractor shall supply sample of the aggregate for the purpose of making preliminary concrete test cubes as herein specified. Once the source is approved by the Consultant/Employer, the Contractor should not change the source unless Consultant instruction to do so.

A2.10. Deleterious Materials

Aggregate shall not contain any harmful materials, such as iron pyrites, coal, mica shale or similar laminated material, clay, alkali, soft fragments, sea shells, organic impurities etc., in such quantity as to affect the strength or durability of the concrete or in addition to the above for reinforcement concrete, any material which corrodes the reinforcement. Aggregate, which is chemically reactive with the alkalis of cement, is harmful and shall not be used, as cracking of concrete may take place.

A2.11. Fine Aggregates

Fine aggregate shall be natural sand derived by crushing suitable gravel or stone and shall be free from coagulated lumps. Sand derived from a stone unsuitable for coarse aggregate shall not be used as fine aggregate.

The fine aggregate shall conform to the requirements of IS 383 - 1970. Fine aggregate shall contain no more than 3% of material removable by decantation test not more than 1% dry lumps. The total of coal, clay lumps, shale fragments and other deleterious substance shall not be more than 5%.

The percentage of clay clumps shall be determined by examining the various fractions that remain after the materials has been tested for grading. Any particles that can be broken with fingers shall be classified as clay lumps and the total percentage of clay lumps shall be determined on the basis of the total original weight of the samples. Fine aggregate shall be determined on the basis of the total original weight of the sample. Fine aggregate shall be well graded from fine to coarse and shall meet the following graduation requirements:

A2.12. Table – I GRADTION FOR FINE AGGREGATE

Percentage by Weight Passing					
Sieve Size Mm	10	No. 4	No. 16	No. 30	No.50	No. 10
Percent passing 100 mm		95 - 100	45-80	25-55	10–30	2–100

Blending will be permitted in order to meet the gradation requirements for the fine aggregate.

A2.13. Coarse Aggregate

The coarse aggregate shall be crushed stone or uncrushed gravel. The pieces of aggregate shall be angular, friable, flaky and laminated pieces, mica shale only the present in such quantities as not to affect adversely the strength and durability of the concrete as ascertained by tests on concrete cubes. After twenty-four hours immersion in water, a previously dried sample shall not have gained more than 5% in weight and not more than 10% if it is to be used in plain concrete or elsewhere as described. The coarse aggregate shall conform to the requirements of IS 383 - 1970. The percentage of wear at 500 revolutions of Los Angeles Rattler Test shall not be more than 50%. The coarse aggregate shall meet the gradation of Table 2.

A2.14. Table – 2

Sieve	Percentage by Weight passing Sieves			
Designation (Sq. Opening)	40 mm	20 mm	16 mm	12.5 mm

Percent passing	100	95 – 100	30-70	0 – 5

A2.15. Measurement and Proportioning of Concrete Materials

The aggregate shall be measured by volume in a gauge box of correct and approved size based on the weight of the material or by other approved accurate means. The gauge box or other container shall be filled with the aggregate without compacting to a predetermined uniform depth accurate allowance being made for bulking due to moisture content of the fine aggregate.

The cement shall be measured by weight, one or more complete bags containing 50 kg / bags being used for a single batch of concrete and as the size of the mixer shall permit this to be done.

The normal proportion of cement and aggregate shall comply with the quantities specified below for the concrete described for each part of the work. The specified quantities shall be altered if instructed after examination of the aggregate materials in samples or in bulk in order to obtain the densest concrete with approved materials. Any such alternations between fine and coarse aggregates shall be made without any alternation in the charge made by the Contractor.

A2.16. Properties of Concrete

Concrete Proportion

The minimum cement content in the mixture shall be as per IS 456: 2000.

The quantity of water used shall be varied to suit the moisture content of the aggregate and shall be just sufficient to produce a dense concrete, consistent with practical workability.

A2.17. Concrete Grade and Strength

The specified concrete strength shall meet the requirements of IS 456 -2000. The compressive strength (cube strength) for Portland cement concrete shall be in accordance with IS 456 - 2000, from which the following figures are taken:

Grade	Specific Characteristic Compressive Strength at 28 Days
M10	10 N/ mm^2
M15	15 N/ mm^2
M20	20 N/ mm^2

M25	25 N/ mm^2

A2.18. Control of Concrete

a) Preliminary Tests

The Contractor shall be called upon to submit representative samples of materials to be used for concrete in order that they may be tested at a laboratory and the suitability of materials established. All expenses in connection with the above materials tested shall be borne by the Contractor.

b) Design Mix and Test

Before the execution of works, the Contractor shall make a design mix and test it as per IS 456 - 2000. In the absence of design mix, ratio as given in IS 456 - 2000 and as approved in writing by the Consultant/Employer may be adopted for work.

But it is the sole responsibility of the Contractor to ensure that such mix conforms to the strength and all other criteria requirements given in IS 456 - 2000. If such mix fails to meet any of the criteria, the Consultant/Employer may instruct to change the mix ratio until all the criteria as stated in IS 456 - 2000 are met without any additional cost to the Employer.

c) Works Cube Tests

During the progress of the work 15 cm cubes shall be made as per IS 456 – 2000 as necessary and tested in accordance with IS 516 – 1959. Minimum number of cubes for every work shall be as per IS 456 – 2000 or its latest edition. The Consultant's/Employer's representative shall record the concrete used in the project from these batches and a record maintained. Failure of cube tests may warrant demolition of related works in the project from the failed batch. Cube testing will be done in 7 days & 28 days from the date of casting.

A2.19. Measurement of Consistency

The consistency shall be determined by making trial mixture with dried aggregate. The consistency of the trial mixture of approved consistency shall be measured as instructed.

The slump of approved trial mixture shall be measured, and this slump shall not be exceeded throughout all batches of concrete made from the same materials mixed in the same proportions as the trial mixture and used in those parts of the work as instructed. In no case, however, shall the slump exceed 50mm for concrete in slabs, or exceed 25 mm for concrete consolidated by mechanical vibration. The slump test shall be made on concrete actually being placed in the works at the commencement of each grade of concrete placing and such other times as instructed. The apparatus used for the slump test shall be standard cone. When the cone is filled it shall be raised vertically clear of the concrete and measurement of the slump shall be

measured. Care shall be taken to prevent vibration of the sample being tested. If the Consultant/Employer requires the use of other means for testing the consistency of the concrete it shall be done as instructed without any extra charge.

A2.20. Concrete Mixing

The cement and aggregate shall be thoroughly mixed together in the specified proportions by volume or weight in a batch type mechanical mixer, unless another type of mixer is approved. The water shall be admitted to the drum of the mixer only when all the cement and aggregate constituents and batch is in drum. The concrete shall be mixed until the mixer is of uniform colour and in no case of less than minute. If the drum rotates at lower speed, the minimum period shall be increased inversely proportional to that speed. The period of mixing shall be measured from time when all the materials and water are in drum. The mix shall be discharged before materials for the succeeding batch are fed into the drum. Materials spilled from the skip or other container shall not be used. No partly set or frozen concrete shall be used in the work. Partly set concrete shall not be re-mixed with the addition of cement or aggregate.

A2.21. Preparation for Placing Concrete

Before the concrete is placed the shuttering shall be trued – up and any water accumulated therein shall be removed. All saw dust, ships, nails and other debris shall be washed out or otherwise removed from within the formwork. The reinforcement shall then be inspected for accuracy of fixing. Immediately before placing the concrete the formwork shall, except in frosty weather, be well wetted and inspection openings closed. The Consultant/Employer may instruct the use of a medium gauge polythene sheet laid over the shuttering in which case the Contractor at no extra charge to the project shall provide it. Suitable release agents as per relevant IS codes shall be used.

A2.22. Placing Concrete

The interval between adding the water to the dry mix and completion of the concrete placing operation shall not exceed 30 minutes nor, when an approved admixture that accelerates the initial setting of the cement be used, exceed minutes.

Except where otherwise approved for slabs and large sections concrete shall be placed in the formwork by shovels or other approved implements and shall not be dropped from height of more than 1.5 m or shall not be handled in a manner to cause segregation. Accumulations of hardened concrete dropping on the reinforcement shall be avoided. Concrete shall be sorted along the formwork of that position.

Each layer of concrete while being placed shall be consolidated by approved methods of ramming, tamping or mechanical vibrations to form a dense surface free from honey combing and tolerably free watermarks and air holes or other blemishes.

The concrete shall be tamped against the face of the formwork so as to produce dense fair surface. The number and type of mechanical vibrations shall be approved before consolidating by vibration. Placing and consolidation of concrete shall be done in such a manner as not to disturb concrete already placed and reinforcement projecting from concrete already placed shall not be vibrated or jarred. For concreting reinforced concrete walls and other structures having lateral dimensions of 125 mm or less, each layer of concrete while being placed shall be properly consolidated by approved methods of mechanical vibrations produced by internal or external mechanical vibration.

Any water accumulating on the surface of the newly placed concrete shall be removed by approved means and no further concrete shall be placed thereon until such water is removed. No fresh concrete shall be brought into contact with the concrete containing cement of a different type. Unless otherwise approved or instructed, concrete shall be placed in a single operation to the full depth of slab, beam and members similar thereto and shall be placed in horizontal layer not exceeding 900 mm deep in walls, columns until completion of the part of the work between construction joint as specified shall be made. If a temporary cessation of concrete placing be unavoidable elsewhere, a construction joint shall likewise be made.

A2.23. Placing Concrete in Extreme Weather

Work shall be done according to IS 456 – 2000

A2.24. Vibration

a) Appearance

The concrete that is to be compacted by vibration appears anything from earth dry to slightly glistening. The mix should have the appearance of lacking in fines.

b) **Placing**

Segregation is likely to take place when the concrete is tipped into the form, and this should be avoided. The concrete mix should not contain surplus water and sand, which develop segregation under influence of vibratory compaction. The distribution of new concrete should be uniform for the whole section and the surface kept horizontal the whole time, thus ensuring the movement of concrete is downward only. Vibrators shall not be used as a spreading or distributing agent.

The vibrators shall be of rotary out of balance immersion type or the electromagnetic type and operate at a frequency off not less than 4000 cycles per minute. The vibration shall be of such a power – input as to produce an acceleration of 4 to 3 meters / See in the mass of the compacted concrete. The vibrator shall be provided for continuous operation. The Contractor at no extra cost shall use needles or plate vibrators, if instructed by the Consultant/Employer.

c) Disposition of Vibration

Internal vibrator shall be disposed within the mix, when placed, so as to maintain the whole pf the concrete under treatment in an adequate state of agitation such that de-aeration and effective compaction may be attained at a rate commensurate with the supply of concrete from the mixers. Insertion of vibrator at about 450 mm Centre is considered sufficient.

d) Period of Vibration

Vibration shall continue during the whole period occupied by placing the concrete, the vibration being adjusted so that the Centre of vibration approximates to Centre of the mass being compacted at the time of placing. The concrete should not be over vibrated and the period of insertion of internal vibrator should be about 15 seconds at any point.

e) Compactness

The concrete shall be judged to be compacted when the mortar fills the spaces between the coarse aggregate so as to form a glistening and even surface except for slight irregularities where the coarse aggregates break this smooth surface. When this condition has been attained the vibrator shall be withdrawn slowly.

The vibrator must not be placed against the steel or the formwork, the minimum distance being 75mm. The compressor must be placed in such a position that formwork reinforcement and recently laid concrete are subjected to the minimum amount of vibration.

A2.25. Construction Joints

Construction joints shall be made in the portions hereinafter specified or elsewhere as approved. Such joint shall be truly vertical or horizontal as the case may be, except that in an inclined or curbed members the joint shall be stride at right angle to the axis of the member.

Construction joints shall be made horizontally at top of the foundations and horizontally 75 mm below the lowest beam soffits at the head of columns. Concrete in the ribs and slabs of small tee, all beams concrete in the rib up to a level 25mm below the slab soffits shall be placed first.

Concrete haunches or splays on the beams or braces and concrete in the head of adjoining portion of the columns shall be placed at the same time as that in the beams or braces. Concrete in splays at the joints in the length of abeam shall be avoided where practicable, but where joints are unavoidable, they shall be made parallel to the main reinforcement, and where

required at right angles to the main reinforcement, they shall be made at a placed previously approved by the Consultant/employer.

A2.26. Protection and Curing of Concrete

Immediately after placing or finishing, concrete surfaces not covered by forms shall be protected from loss of surface moisture for at least seven days when the average daily temperature is at least 21 C, where Portland cement has been used. Protection from loss of surface water shall be done by any of the following methods where applicable to the type of work involved:

a) by water covering

b) by covering of surface with water – impervious paper

c) by application of approved impervious membrane.

Surface from which forms have been removed before the curing period has elapsed shall be protected as specified for surfaces not covered by forms. Membrane curing shall not be used in surface required to receive additional concrete or concrete fill, nor on cement finish coats that are to receive dust proofing or hardening treatments, or during hot weather.

Water curing shall be performed by keeping the concrete surface wet by pounding, by continuous spraying or by covering the surface with an approved water saturated covering such as 25mm of sand of sawdust, or by one or more layer of burlap. The exposed concrete surface shall be saturated with water throughout the full – stipulated curing period. Where forms remain in place during the curing period, they shall be kept sufficiently wetted with clean water to reduce cracks and prevent joints from opening in the forms.

The impervious membrane curing compound shall be an approved non – bituminous, colourless liquid sealing compound in atomized form so as to preserve the natural colour of the concrete. The curing compound shall be applied as soon as surface water has disappeared from concrete surface with approved pressure spraying equipment in accordance with the manufacturer's directions and in sufficient thickness to form an effective water seal. No compound shall be used which will adversely affect the subsequent installation of finished flooring.

Joints of sheet membrane used for curing shall be lapped 150mm and sealed with waterproof tape as recommended by the manufacturer. Polythene sheet shall be considered the water – impervious paper for purposes of interpretation of this item. No liquid curing compound may be used without specific written approval of the Consultant/Employer regarding type, manufacturer, location and extent of use and application procedures.

A2.27. Rectification of Defective Works

Immediately after stripping of formwork, minor defects and honeycombed areas shall be patched and holes filled before the concrete is thoroughly dry. Patch area shall be chipped away to 25 mm depth, with regular edge perpendicular to the surface. Area to be patched shall be thoroughly wet including the areas at least 150mm wide entirely surrounding them, just prior to placing the patching mortar. Mortar shall be of the same materials and proportion as used for the concrete, without coarse aggregate.

A sufficient quantity of white cement shall be substituted for part of the ordinary cement so that the patching mortars, when dry, will match the surrounding concrete. Water in the mix shall be kept to a minimum and mortar shall be re-tempered without adding water and shall be allowed to stand for one hour prior to use during which time it shall be mixed to prevent setting. The mortar shall be thoroughly compacted into place, screened so as to leave the patch slightly higher than surrounding surface, left undisturbed for one to two hours to permit initial shrinkage and finished to match the adjoining work. Where patches exceed 25 mm deep, they shall be Trimmed and wet as specified, after which the opening shall be filled to within 25 mm of the surface. After sufficient shrinkage time has elapsed, the patching shall proceed as described above, patched shall kept wet for five days. Tie holes left by the withdrawal of rods, or holes left by the removal of ends of ties shall be filled solidly with mortar. For holes passing entirely through the wall, plunger type grease gun or other device to force mortar through the wall, starting at the back face, shall be used. When a hole is completely filled, excess mortar shall be struck off with a cloth flush with the surface. Holes not passing entirely through walls shall be filled solidly with mortar. Any excess mortar shall be struck off with a cloth on the wall surface. The surface of non- shuttered faces concrete work other than slabs shall be smoothed with a wooden float (or if approved) with a steel trowel to give a finish equal to that of the rubbed down shuttered faced. Concealed concrete faces shall be left as it is except that honeycombed surface shall be made good.

The top faces of slabs not intended to be surfaced shall be levelled and floated to a smooth finish at the levels of falls shown on the drawings or elsewhere.

The floating shall not be executed to the extent of bringing excess fine material to the surface. Ribbed surfaces of slabs shall where instructed be formed at the time of tamping and levelling. Approved implements giving the depth and patterns instructed shall form indentation in slab or stair surface. The top faces of slabs intended to be covered with screed, granolithic or similar surfacing shall be left with a spade finish.

The soffits of slabs and faces of walls intended to be rendered shall be roughened by approved means to form a key. Concrete surface to take finishes other than those specifically referred to herein shall be prepared in an approved manner to suit the finish as instructed.

A2.28. Test of Structure

The Consultant/Employer shall instruct that a loading test is made on the works or any part thereof if in his opinion such a test be deemed necessary for one or more of the following reasons:

a) The site – made concrete test cubes failing to attain the specified strength.

b) Over-loading during construction of the works or part of thereof.

c) The shuttering being prematurely removed.

d) Concrete improperly cured.

e) Any other circumstances attributable to alleged negligence on the part of the Contractor, which in the opinion of the Consultant/Employer may result in the works or part thereof being less than the expected strength.

f) Any reason other than the foregoing.

If the loading test be instructed to be solely or in part for the reason (a) the test shall be made at the Contractor's own cost.

If the test be instructed to be made for one of the reasons (b) to (e) inclusive the Contractor shall be reimbursed for the cost of the test if the result thereof be satisfactory.

If the test be instructed to be made for the reason (f) the Contractor shall make the test and shall reimburse for all cost relating thereof irrespective of the result of the test.

For the purpose of a loading test on floors, roofs and similar structures and their supports, the test load shall be equivalent to 1 and 2/3 times the superimposed load for which the works or part thereof to be tested has been designed. The test load shall not be applied within 90 days (or 28 days if rapid hardening Portland cement be used) of the completion of placing of the concrete in the part of the works to be tested, and latter shall not be supported during the test by shuttering or other supports. Means shall be taken to ensure that in the event of a failure under the test temporary support of the loaded member shall be immediately available. The test shall proceed strictly as instructed. For the loading test on floors, roof or similar structures the result shall be deemed satisfactory if upon removal of the test lead the residual deflection does not exceed one – quarter of the maximum deflection after 24 hours loading. If the residual deflection exceeds this amount the test loading shall be repeated, and the result shall be

deemed to be satisfactory if the residual deflection after removal of the second test load does not exceed one quarter of the maximum deflection occurring during the second test.

If the result of the loading test be not satisfactory the Consultant/Employer shall instruct that part of the works concerned shall be taken down or removed and reconstructed to comply with this Specification, or that such other remedial measures shall be taken as to make the work secure.

If the test be instructed to be made for one or more of the make the works secure. If the test be instructed to be made for one or more of the reasons (a) to (e) inclusive as herein before specified, the Contractor shall take down or remove and reconstruct the defective work shall take the remedial measures instructed at his own cost.

A2.29. Measurement of RCC Members

In calculating the contents of any RCC member, for measurement purpose the dimensions adopted shall be structural concrete members exclusive of any finish.

a) Raft Slabs and Beams

It shall be measured in cum. of work done as per drawing. Measurement shall be done for the raft concrete below the column junction to the raft slab / beam. Nothing extra shall be paid for any odd size of shapes.

b) Beams

Measurement shall be between RCC columns on walls cubic meters of the work done as shown on the drawing. The depth shall be taken from bottom of the stem to the top of the slab for chhajja if any. Lintels when connected to main RCC structure shall be measured as beams. Except in the case of lateral or horizontal RCC nominal ties used to stabilize certain walls, parapet etc.

c) Columns

These shall be measured in chum. of the work done according to the drawings from top of the footing or raft slab to the top of slab in case of ground floor and from top of slab to the slab for all other floors. Unless specified otherwise nothing extra shall be admissible for any odd size and for any social

d) Slabs

These shall be measured in cu. m. of the work done as per drawings. These shall be measured from beam to beam, wall-to-wall or beam to wall including bearing part on the wall. Unless otherwise specified in the schedule nothing extra shall be admissible for slabs laid to slopes, canopy slabs or those of any shape or section, any cantilever part of any projections small or big beyond the bearing beam or wall as any be shown on drawings or the slabs sunk for lavatory. Plaster shall be paid for separately.

e) Walls

These shall be measure from end of slab / column /beam, termed wall. It shall be paid in cubic excluding the finish.

f) Lintels

All lintels precast or cast in situ spanning over independent opening unrelated to main RCC structures shall be measured under lintels, in cubic meters of the work done according to drawing. Width of the lintels shall be taken according to wall thickness specified unless set back of projected or shown on the drawings, bearing over the opening shall be depth of the lintel of 150m whichever is higher.

g) Stairs

These shall be measured in cubic meters of the concrete work done as per drawing. Unless specified otherwise extra shall be admissible for steps laid in any shape of not straight in plan.

h) Fold Staircase

The fold staircase shall be measured excluding the vertical main column. It shall be measured for step of any shape size and paid in cubic meters excluding the finish.

i) Fins and Louvers

The RCC fins or louvers as provided shall be measured and paid cubic meters. Nothing extra shall be allowed due its shape, location or size.

j) Fascia and Parapets

These shall be measured in cubic meters of the concrete work done as per design, drawings, exclusive of finishing. For sill all projections up to 100mm beyond the wall on either side shall be made without any extra charge and these shall be inclusive of forming any pattern of drip mould.

k) Mullions

The RCC mullions shall be measured and paid in cubic meter. Nothing extra shall be admissible for its location, shape or size.

l) Water Tank

These shall be measured for all the slab, wall etc. forming the water tank. Nothing extra shall be allowed for its shape, size and location. It shall be paid in cu. m. of the concrete work.

m) Column Footings

These shall measure in cu. m. of the concrete work done as per design, drawing. Unless specified otherwise nothing extra shall be admissible for any shape of the footing.

A3. REINFORCEMENT

A3.1. Supply and Fixing of Steel Reinforcement for RCC Work

Supplying and fixing for steel reinforcement confirming to IS 1786 - 1966 or IS 1139 – 1966 in RCC work including bending, binding with binding wire, placing in position including the cost of binding wire, as per drawing.

Supplying and fixing tor steel reinforcement conforming to IS 432 - 1966 in RCC work including bending, binding with binding wire, placing in position including the cost of **binding wire, as per drawing.**

Reinforcement shall be free from pitting due to corrosion, loose rust, mill scale, paint, oil, grease, adhering earth, ice or other materials that may impair the bond between the concrete and the reinforcement or that may in opinion of Consultant/Employer cause corrosion of the reinforcement or disintegration of the concrete. Adhering lime wash or cement grout shall be permitted.

A3.2. Bar Reinforcement

Bar reinforcement described as “mild steel” shall be plain round hot rolled steel bars. Bar reinforcement described as “tor steel” shall be hot rolled deformed bars or cold twisted steel bars. With respect to manufacture, quality, physical properties and related requirement, reinforcement of the foregoing descriptions shall comply with appropriate parts of IS Standards Nos. 432 – 1966, 1139 – 1966 and 1786 – 1966 for mild steel and High Yield Strength deformed bars steel respectively.

A3.3. Certificates and Test for Reinforcement

For each consignment of bar reinforcement used in the works, the Contractor shall, if required, supply a certificate showing the ultimate strength, yield stress and elongation and the result of the cold bend test for each size of bar. A test for the purpose of obtaining the information shall conform to relevant IS.

The reinforcement supplied for which the maker’s tests sheets or other record be not available, or where in the opinion of the Consultant/Employer materials has been subjected to corrosion or other bad effects, the Consultant/Employer shall select as many test pieces as he deems necessary, and the Contractor shall supply and deliver the test piece of cost without reimbursement and pay the cost of preparing and testing them as well.

A3.4. Dimensions of Reinforcement

The size of a reinforcement bar described on the working drawings or elsewhere shall be the minimum and the rolling margin and other tolerance shall be wholly above this size. The length

of a reinforcement bar shall be not less than the length on the drawing or elsewhere and shall be not more than 50mm in excess of that length. Bar bending schedule shall be prepared by the Contractor and submitted for approval of the Consultant/Employer. The schedule shall be prepared based on reinforcement details, prior to the execution of the work. Nothing extra shall be paid for this.

A3.5. Bending Reinforcement

Reinforcement bar shall be bent by approved means producing a gradual and even motion. Bar shall comply with the dimensions described in the drawings. Overall dimensions of bent or internal dimensions of bending or the like shall be within a tolerance of 38mm. Any discrepancies or inaccuracies found by the Contractor in the drawings or other documents shall be immediately reported to the Consultant/Employer whose interpretation and requirement relating thereto shall be accepted. Hooks and other end anchorage bends for mild steel shall be bend to an internal radius of the twice diameter of the bar. This internal radius off the bends at corners of binders or strips or links shall be half of the size of the bar embraced by the binder stirrups or links.

A3.6. Fixing Reinforcement

Reinforcement shall be accurately located and fixed in place by approved means in the positions described. Bars intended to be in contact shall be securely wired together at all such point with 16-gauge soft iron tying wire or welded joints, Binders, stirrups and links shall tightly embrace the bars with which they are intended to be in contact and shall be securely wired or, if approved, spot welded thereto.

Reinforcement shall be lapped, joined or specified only at the positions described. Splices and the like found to be necessary elsewhere should be formed only if and as instructed. Lapping shall be provided as shown in the drawing and as permitted.

Where practicable bar in each member shall be assembled and fixed in the form of a rigid cage or skeleton correctly in position with required cover during the placing and consolidating of the concrete.

Immediately before concreting, the reinforcement shall be checked for position, cleanliness, and freedom from rust or retarding liquid. Means shall be taken to ensure that reinforcement remains correctly in position with required cover during the placing and consolidating of the concrete.

Reinforcement projecting from work being concreted or already concreted shall not be bent out of its correct position for any reason unless approved and shall be protected from deformation or other damage. Reinforcement left projecting for bending with future extensions shall be thoroughly coated with cement grout wash or encased in concrete or otherwise protected from corrosion as instructed.

A3.8. Cover of Concrete and Spacing of Bars

Unless otherwise described the clear cover of concrete to the reinforcement shall be as per IS 456 - 2000 or its latest revision.

A4. FORMWORK

Cantering and shuttering including propping, strutting etc. and removal of forms including applying Form Oil to Shuttering

A4.1. Design

Formwork shall be so designed and constructed for removal that concrete can be properly placed and thoroughly compacted. Formwork shall be firmly supported and adequately strutted, braced, or tied. It shall be capable of adjustment to the lines and dimensions of the finished concrete, and it shall be sufficiently strong to resist without distortion, the pressure of concrete during its placing and compaction, and other loads to which it may be subjected. It shall not be liable to suffer distortion under the influence of the weather. When concrete is to be vibrate, special care shall be taken to ensure that the formwork will remain stable and the joints tight. The safety and adequacy of Cantering and shuttering shall be the sole responsibility of the Contractor. The Contractor shall if required supply to the Consultant/Employer drawings and calculations for the formwork that proposes to use.

A4.2. Deflection and Camber

The Contractor shall make allowance for any settlements of deflection of the formwork that is likely to arise during construction, so that the hardened concrete conforms accurately to the specified line and level. The Contractor shall also make allowance in the formwork for any camber specified by the Consultant/Employer to allow for the elastic deflection of structural members and deflection due to creep of the concrete. In the absence of any specified camber, the soffits of all beams and slabs shall be given a camber equal to 1 / 240 of the span length to ensure that the structure has the prescribed shape after removal of the form.

A4.3. Supports

Formwork shall be constructed so that the formwork to the sides of members can be removed without disturbing the soffits formwork or its supports. Props and supports shall be designed to allow the formwork to be adjusted accurately to line and level and to be erected and removed in an approved sequence without injury to the concrete. Support shall be carried to construction, which is sufficiently strong to afford the necessary support without injury to any portion of the structure. This may mean in some case that it be carried down to the foundation or other suitable bases. Props and bracing shall be provided for the temporary support of composite construction where separately specified.

A4.4. Joint and Edges

All joints in the formwork shall be close – fitting to prevent leakage of grout from the concrete. At construction joints compressible treated fibre board shall be tightly secured against previously cast or hardened concrete to prevent the formation of stepping of ridge in the concrete. Formwork shall be constructed to provide straight and true angles, and edges. Where chamfers are shown on the drawings, the fillets shall be accurately cut to size to provide a smooth and continuous chamfer. Formwork panels shall have true edges to permit accurate alignment at sides and provide a clean line at construction joints in the concrete, which shall be fixed with their joints either vertical or horizontal unless otherwise instructed. Refer clause “Preparation for placing Concrete.”

A4.5. Sundries

Formwork shall be provided to the top surface of concrete where the slope or the nature of the work required it. Provision shall be made for providing blackout of timer for forming holes and chases for services and for building in pipes, conduits, door floor spring closes and other fixings, as required whether shown in the drawings or not. The materials position of nay ties passing thorough the concrete shall be to the Consultant’s/Employer’s approval.

Except where corrosion of a metal tie is unimportant it shall be possible to remove a tie so that no part of the concrete than the specified thickness of cover to the reinforcement. Any holes left after the removal of ties shall be filled with concrete or mortar of approved composition.

A4.6. Cleaning and Treatment

Space to be occupied by concrete shall be free from all rubbish, chipping, shavings, sawdust, dirt and tying wire etc. before concrete is placed. The formwork to be in contact with the concrete shall be cleaned and treated with a suitable non – staining for form oil or other approved

material. Care shall be taken that oil or composition joints. Surface retarding agents shall be thoroughly cleaned after each use. Damaged or distorted formwork shall not be used.

A4.7. Striking or Removal of Formwork

All formworks shall be removed without shock or vibration that might damage the concrete. Before the soffits and props and removed the surface of the concrete shall be exposed where necessary in order to ensure that the concrete has hardened sufficiently. In no circumstances shall formwork be struck off until the concrete reaches cube strength of at least three times the stress to which the concrete may be subjected at the time of striking.

The formwork to vertical surfaces such as wall, column and side of beams may be removed after 9 hours in normal weather conditions although care must be taken to avoid damage to the concrete, especially to edges and features. In cold weather a longer period may be necessary before striking. Suitable curing methods should immediately follow the removal of the formwork. The following minimum times shall elapse before removal of formwork.

Type of Formwork	**Minimum period before Striking Surface Temperature of concrete**	
	16 °C	**7** °C
Vertical formwork to columns, walls and larger beams	24 hours	24 hours
Soffits formwork to slabs	14 days	18 days
Props to slabs	18 days	21 days
Soffits formwork to beams	15 days	21 days
Props to beams	21 days	28 days

The times given for the removal of props are based on the assumption that the total live load plus dead weight to be supported at the time of removal is not more than one half the total design loads. For horizontal members where the loading is a higher proportion of the total design load may need to be increased.

Measurement

No extra payment will be made.

A4.8. Workmanship and Materials

Where concrete is described as having an off-form finish, formwork itself shall be of a good finish to achieve the off-form concrete surface smooth and even, free from all board marks, projection, pits and honeycombing etc. and all edges shall be square, straight and true. The Contractor shall specially see that the finished exposed surface should be smooth and even so that no rendering or plastering is required. The material shall be either hardboard or waterproof

plywood with taped joints or any other approved material. The Consultant/Employer shall approve the finish.

Measurement

No extra payment will be made.

BRICKWORK

A4.9. Kiln made first class brick in foundation and plinths in cement mortar 1: 6 (1 cement: 6 sand) for brickwork.

A.4.10 Machine-made first-class brick as above plinths in cement mortar 1:6 (1 cement: 6 sand) for bricks works

a) Bricks

The bricks shall be kilning machine made wire cut cast bricks of first-class quality confirming to IS 1077. These shall be of quality approved by the Consultant/Employer free from cracks grit and other impurities such as lime, iron and other deleterious salts. These shall be well-burnt, sound, hard with sharp edges and shall omit a ringing sound when struck with a mallet. These shall be of uniform size.

b) Mortar

Cement mortar shall be of proportion as indicated. The ingredients shall be mechanical pan mixer; too much water shall not be used. River sand shall be used unless otherwise specified. If hand mixing is allowed, then is shall be done in brick tanks. The gauge material shall be put in the tank and mixed dry. Water will then be added and the whole mixed again until it is homogeneous and of uniform colour. The ingredients i.e. cement, sand and water shall be described under concrete works. Bricks shall not show any sign of efflorescence when dry or subsequent to soaking.

The bricks shall not absorb more than 7% of its weight after 5-hour boiling test.

Bricks shall not be dumped at the site. Bricks shall be carefully stacked in regular layers and otherwise handled and stored at all times so as to avoid damage. The standard brick sizes shall be 230mm x 110mm x 55mm. Dimensional tolerance shall be 3mm in any direction.

The bricks shall be cut and filled to the shape shown on the drawings or as required to meet the dimensions and shapes indicated or as required to watch the existing.

c) Workmanship

All the bricks shall be thoroughly soaked in water before use till the bubbles cease. The bricks shall be laid in cement mortar beds in proper bond. When bonding, the brickwork must be set back in every course. The vertical toothing shall be accepted. The course shall be truly horizontal and the work strictly in plumb. The mortar joints shall not exceed 10 mm and minimum 6 mm in thickness. The joints shall be broken vertically. All the joints shall be raked out to a depth of 6 mm to receive setting beds render and / or for pointing work where required.
The walls are to be carried up in a uniform manner with level course and propound strictly kept no one portion being up more than 14 single courses per day. The top of the walls shall be well settled before the work recommences.

There shall be smooth mortared surface to receive any structural slab, beam, lintel etc. on the brick courses. The brickwork shall be well watered at least for 14 days. The brickwork shall be thoroughly cleaned off on completion.

A4.11 Kiln made first class brick in super structure in cement mortar 1:6 (1 cement: 6 Sand) for 9" thick brick wall and in cement mortar 1:4 (1 cement: 4 sand) for 4 ½" thick brick.

A4.12 Machine-made first-class brick as above

Workmanship

All the work shall be done as per specifications. The maximum lift involve above plinth level shall be 15 m. Scaffolding of required nature shall be provided as necessary.

A4.13. Protection and Curing

All brick work shall be protected from rain by suitable covering when the mortar is green. The masonry work shall be kept constantly moist on any face for a minimum of seven days. Care must be taken to protect brick edges during and after construction. All the exposed brick works shall be cleaned of all the foreign material.

A5. PLASTERING WORK

Cement sand plastering on floor, wall ceiling etc. of good finish including raking the joints, wetting the surface and curing the work all complete, in Sq. m.

i. 12 mm thick cement sand plaster (1: 4)
ii. 12 mm thick cement sand plaster (1: 6)
iii. 20 mm thick cement sand plaster (1: 4)
iv. 20 mm thick cement sand plaster (1: 6)

v. 25 mm thick cement sand plaster (1: 4)

vi. 25 mm thick cement sand plaster (1: 6)

a. Materials

i. Cement – Ordinary Portland Cement as per specification

ii. Sand – River sand as per specification

b. Proportion

As specified in the schedule.

c. Mixing

In specified proportion as per specification.

d. Plastering

The joints in the brickwork shall be racked out to a depth of 12 mm if it has not already been done; and the surface watered and cleaned of all dust and dirt. Concrete surfaces shall be properly hacked to get adequate key. The mixture shall be applied evenly with force on the surface to be plastered. The plastered shall be of thickness as specified in the schedule. The surface shall be finished at once by being rubbed over with trowel till the cement appears on the surface. All corners, angles and junctions shall truly vertical and horizontal as the case may be and carefully and nearly finished. Rounding of corners and junctions where required shall be done without extra charge. The finished plastered shall then be left to cure for 10 days.

A6. WOOD WORK (AS APPLICABLE)

A6.1 Timber

a) **Quality**

Timber shall generally conform to IS 287 – 1960. Timber to be used for the work shall be from the heart of a sound tree of mature growth, the sapwood being entirely removed. It shall be uniform in substance, straight in fibber, free from large, loose dead or cluster knots, flows, shakes, wasp, cup spring, twist, bend and defects of any kind. It should be free from spongy, brittle, flaky or brushy condition, sapwood and borer holes.

b) **Kind**

The timber shall be of best quality timber as specified in the item. The samples of the approved timber to be used shall be disposed in the office of Consultant/Employer for the purpose of comparison.

c) **Colour**

The colour shall be uniform as far as possible, darkness of **colour** amongst colour species of timber being generally a sign of strength and durability.

d) **Moisture Content**

The moisture content for the timber shall not exceed 12 percent of dry weight of timber. The moisture content should be tested if the Consultant/Employer feels it's required.

e) **Stacking**

As soon as the foundation of building are laid all necessary timber, scantling shall be brought to site and stacked as laid down in IS 401 – 1967 till required.

Timbers for the works shall not be brought to site of work until seen and approved by the Consultant/Employer who may reject the defective timber works. Any effort like plugging, painting using any adhesives or resinous materials to hide defects shall render the pieces rejectable by the Consultant/Employer. Timber presented for inspection shall be clean and free from dust, mud, paint, or other material, which may conceal the defects. Cut off ends for protection can be done after inspection with raw linseed oil or any other materials approved by the Consultant/Employer No timber shall be painted, tarred or oiled, primed without the previous permission of the Consultant/Employer.

f) **Sawing**

All scantlings shall be swan in straight lines, planes and of uniform thickness with full measurement from end to end and shall be sawn in the direction of the gain. They shall be sawn with such sufficient margins as to secure specified dimensions lines and planes after wrought and dressed. Any timber rejected shall at once be removed from the site of work.

A7. DOORS

A7.1 Providing and fixing seasoned dressed Sal timber frames in doors made of specified size and as shown in the drawing.

Construction

When ventilator is provided above the door, full length of the vertical post shall be provided. Joints in frames vertically. Style or horizontal rail shall not be allowed. The unrelated edges of the frames in the opening shall be rounded or beaded uniformly.

The rebate and the plaster key grooves shall be provided as shown in drawing. Vertical part of the frame shall be embedded at least 30 mm in the masonry or concrete of flooring. Holdfasts shall be provided as specified and any adjustment of spacing necessary shall be erected in position and held in plumb with proper supports from both sides and built in masonry as it is being built.

The work shall be as per drawing. The timber shall be properly planned wrought and dressed in a workman like manner. Joints shall be rued to fit properly and kind directed by the Consultant/Employer. The rate of woodwork shall include the cost of all sawing, planning fitting, fixing and supplying of all straps, bolts, nails, spikes, key wedges, pins screw etc. necessary for the framing and fixing. Plugging in holes for holdfast shall be done in neat manner. Any defects observed after installed shall be rejected. Samples of workmanship shall be submitted for approval.

A7.2 Galvanized iron wire gauge shutters

Galvanized iron wire gauge shutters with mosquito – proof gauge (14 to 16 mesh to linear 25 mm with 28- or 30-gauge G. I. wire) for openable doors fitted on seasoned salwood frame with good finishing including fixing with 2 nos. hinges of 10 cm length per leaf, one number C. P. handle, 2 nos. C. P. tower bolts of 30 cm. In addition, 15 cm. Length, wooden cleats or M. S. hooks, required number of screws etc. as per drawing, all complete in Sq.m.

a. Materials

i. Timber – As per specification.

ii. Fixture and Fastenings **–** Providing and fixing n position fixtures and fastenings per every leaf.

iii. Galvanized Iron Wire Gauge – Wire gauge shall be of woven wire webbing. It shall be of 14 to 16 mesh to linear 25 mm with 28-to-30-gauge G. I. wire, or as approved by the Consultant.

b. Construction

The workmanship shall be of the best quality. The stiles, rails, etc. shall be rebated 12mm along the side to receive the wire gauge. The galvanized iron fly proof webbing 14 to 16 mesh to 25 mm linear length shall be used unless otherwise specified. The webbing shall be bent at 90 at 12 mm, along both sides to rebate and fixed securely to the sites, rails and mountings by 12 mm galvanized iron staples at about 15cm intervals, staggered spacing. Fillets shall be of salwood of specified timber of size 10mm x 10mm which shall be securely and neatly fixed with small screws spaced at 75mm Centre round the rebate to hold the wire mesh. The sire mesh shall be tightly stretches during fixing. The space between the fillet and rebate where the webbing is bent shall be neatly finished with putty, so that the out ends of the webbing may not be visible. Each shutter shall be fitted with necessary fittings of approved quality as shown on the drawings.

A7.3. Providing and fixing glass in door, clear storey, window ventilator shutter with putty or putty and timber bead as shown in the drawing.

a. Clear glass 3mm thick

b. Clear glass 4mm thick
c. Clear glass 5.5mm thick
d. Wired glass 6mm thick
e. Frosted glass 3mm thick
f. Frosted glass 4mm thick
g. Frosted glass 6mm thick
h. Patterned glass 3mm thick
i. Patterned glass 4mm thick
j. Patterned 6mm thick
k. Red transparent glass 4/6 mm thick
l. Green transparent glass 4/6 mm thick
m. Blue transparent glass 4/6 mm thick
n. Tinted glass of brown colour 6mm thick
o. Tinted glass of dark colour 6mm thick

a. Materials

The glasses used shall be Modi brand or its equivalent. Putty shall be glazing in sealed tins. The glass of specified thickness and type shall be provided of approved make and shade. The glass shall be free from specks, bubbles, air holes, veins blisters or any defects. It shall be of uniform thickness. Samples shall be approved prior to use. All glass shall be free of distortion and waves producing distorted vision or reflection.

b. Workmanship

In the case of metal window glazing, a thin layer of putty is placed in the sash rebate, glass is then pressed into the putty to solid bearing and glazing clips provided. There shall be minimum 4 glazing clips per square meters of glass. After fixing the glazing clips the glass is face puttied and cut to a level edge finish with putty knife. The putty joints shall be continuous and completely watertight. Holes for glazing clips must be drilled prior to installation of the window shutter. Cracked, scratched glass shall be rejected.

A7.4 Providing and fixing position hardware to the doors as per specification and drawings.

i. Decorative bar handles, brass 450 mm
ii. Decorative brass bush plate, 16 SWG thick 450 * 300 mm
iii. Push plate, stainless steel, 125 * 400 mm
iv. Floor recessed auto spring closer, SS cover plate
v. Hydraulic door closer – brass

vi. Door spring closer – brass
vii. Handle, brass, 150 mm, D –type, concealed fixing
viii. Handle, brass iron / aluminium, D-type, zinc coated, concealed fixing
ix. Butt hinge, brass, 150mm
x. Butt hinge, brass, 100mm
xi. Butt hinge, iron, 150mm
xii. Butt hinge, iron, 100mm
xiii. Mortise lock, unkeyed, satin stainless steel
xiv. Mortise lock, keyed, satin stainless steel
xv. Mortise lock, unkeyed, anodized aluminium
xvi. Mortise lock keyed, anodized aluminium
xvii. Tubular cylinder lock, brass, key operated externally, press lock internally Guest room main doors.
xviii. Tubular cylinder lock, brass, unkeyed presses lock internally. Guest room bathroom doors.
xix. Recessed tower bolt, brass, 300mm
xx. Recessed tower bolt, brass, 150mm
xxi. Recessed tower bolt, brass,100mm
xxii. Tower bolt, anodized aluminium, 230mm
xxiii. Tower bolt, anodized aluminium 150mm
xxiv. Tower bolt, anodized aluminium, 100mm
xxv. Door stoppers, brass
xxvi. Door stoppers, anodized aluminium
xxvii. Door stoppers, chrome plated
xxviii. Eye hook, brass 250 mm
xxix. Eye hook, anodized aluminium, 250mm
xxx. Eye hook, iron zinc coated, 250mm
xxxi. Room number, 3 digits each, brass, and 75 mm ht. 6mm thick, concealed fixing, Helvetica numbering style.

All fixing and fastening to be used shall be approved by the Consultant/Employer and shall be fixed as per drawing. These shall be new, sound strong of quality and workmanship. The size shape, design and finish shall be as shown on drawings or directed by the Consultant/Employer. Samples shall be submitted for approval and the approved samples shall be kept in the office of the Consultant/Employer for comparison.

All fixtures shall be fixed to jointing in secure and efficient manner. Any of the fixture damaged during fixing shall be removed and new ones fixed in their places and the surface the journey made good were affected at the Contractor's expense. When the type is not mentioned on the drawings or items, it shall be as directed by the Consultant/Employer. The fastening and fixtures shall be provided as per the fastening and fixture schedule. A pair of 225mm long hooks and eyes shall be fixed to the Ventilator frame and the shutter as directed. If the drawings specify different types of fixtures the work shall be carried out according to the drawing.

If the ventilator is of swing type, then hooks and eyes can be disposed with. The ventilator shall swing about a central horizontal axis on a pair off such centre, chat hooks, one brass ring with screw attached as per drawings or a directed by the Consultant/Employer and good quality if window nylon cord of adequate length for convenient operation of the ventilator shall be provided. A two-pronged brass hook shall be embedded in the wall at the drawing or as directed by the Consultant/Employer. The fixture and fastenings shall be fitted prior to the application of finishes, removed during the finishing operation and reset after completion of the finish. Metal knobs and handles shall be protected by wrappers of the tough or cloth and maintained in till acceptance of the work. Upon completion of work the Contractor shall in presence of the Consultant/Employer show that all fixture and fastening work freely including the brass spring-loaded catch.

A8. FLOORING WORK (As applicable)

A8.1. Providing and laying Kiln Made Dry Flat Brick Soling as Directed

The brick shall chimney made brick. The base on which is to be laid on flat shall be levelled to slope as required and compacted properly. The bricks on flat shall be laid true to line, slope and pattern as required. The bricks shall be closely packed to each other as far as practicable, and gaps shall be blinded with sand. The workmanship shall be to the approval of the Consultant/Employer.

The measurement shall be the net area of length and breadth in Sqm and the rate shall be for all the material and labour.

A8.2. Providing and laying Plain Cement Concrete 1:2:4 on Floor

The work shall be done, as per specification of item 5. The thickness shall be as shown in the drawings and the stone chips size shall be 12 mm and down. The finished surface of the concrete shall be left rough.

A8.3. IPS Flooring Work

The work shall be done as per specification of item 5. The thickness and ratio shall be as shown on the drawings / BOQ. The size of stone chips shall be 12mm and down. The finished concrete surface

shall be left rough and then finished smooth with 1:1 cement sand mortar to the line and level as shown on the drawing and as instructed by the Consultant/Employer.

A8.4. Cement Sand Flooring

Cement sand punning on floor, skirting dado etc. wetting the surface, mixing, laying and rubbing with steel trowel to a hard, smooth and shining surface and curing for a quality finish net all complete.

i. 18mm thick cement sand screenings (1:6) with 3 mm thick cement sand punning (1:1)

ii. 12mm thick cement sand screenings (1:6) with 3 mm thick cement sand punning (1:2)

a. Materials

i. Cement – Portland cement as per specification

ii. Sand – River sand as per specification

b. Proportion

As specified in the schedule.

c. Mixing

In specified proportions per specification.

d. Screenings

The floor surface watered and cleaned of all dust and dirt. The mixture shall be applied evenly on the surface to be base of punning. The screenings shall be of thickness as specified in the schedule. The surface shall be finished at once by being rubbed over with trowel till the cement appears on the surface. Rounding of corners and junctions where required shall be done without extra charge. After one- or two-days punning shall be done.

e. Punning

Before applying cement, sand punning, the first coat should be swept clean of any dust or loose particles. The average thickness of punning shall not be less than 3 The pattern of the surface should be as per instruction of the Consultant/Employer. The coat shall be finished by rubbing with a steel trowel and any depression shall be filled in and rubbed to a shining surface. All corners and edges shall be rounded. The Contractor shall prepare a sample square meter of the punning as per instruction of the Consultant/Employer until the quality, texture and finish required is obtained and approved by the Consultant/Employer, after which all punning work executed shall conform to the respective approved sample. All punning shall be finished smooth, even and truly level and as per instruction of the Consultant/employer. The punning shall be kept waterlogged for 7 days.

A8.5. Ceramic tile Flooring Work

4 mm thick Ceramic tile in floor and wall laid with cement sand mortar (1:6) and (1: 4) respectively. In floor tile slope should be done for drainage wash water, including the finishing of the joint with joint filler of approved colour all complete in Sq. m.

a. Materials

i. Non skidding Ceramic tile on floor

ii. Glazed Ceramic tile in wall

It shall be of good quality having smooth, hard surface, regular in shape, sizes and uniform thickness, of good appearance, and of straight edge. It shall be free from cracks and other defects. Ceramic tile may be of Johnson made or equivalent, the colour and size shall be as per instruction of the Consultant/Employer. Sample or ceramic tile to be used shall be submitted to the Consultant/Employer and his approval should be taken before bulk purchase. All the tiles supplied shall conform to the approved samples in all respect. It shall meet the following specification.

S. No.	Characteristics	Wall	Floor	Remarks
A.	**Dimension & Surface Quality**			
1	Deviation in Length	± 0.2%	± 0.2%	
2	Deviation in Thickness	± 0.2mm	± 3.0%	
3	Straightness of Sides	± 0.15%	± 0.2%	
4	Rectangularity	± 0.15%	± 0.2%	
5	Surface Flatness	± 0.22%	± 0.2%	
6	Surface Quality	Minimum 95%	Minimum 95%	
B.	**Physical Properties**			
1	Water Absorption	14% - 16%	3-4%	
2	Bending Strength	>18 N/mm^2	>30 N/mm^2	
3	Scratch Hardness (Mohs)	Minimum 4	Minimum 7	
4	Surface Abrasion	N. A.	III-V	
5	Crazing	4 Cycles	4 Cycles	
C.	**Chemical Properties**			
1	Stain Resistance	Min Class 1	Min Class 1	
2	Household Chemicals	Min Class AA	Min Class AA	
D.	**Thermal Properties**			
1	Thermal Shock	10 Cycles	10 Cycles	
2	Thermal Expansion	Max 7 E - 06	Max 7 E - 06	

E.	Tile Sizes	12" x 8"	12" x 12"	

b. Proportion

Cement Sand Mortar (1:6) 1 Part cement; 6 parts sand as per specification for floor. Cement Sand Mortar (1:4) 1 part cement; 4-part sand as per specification for wall.

c. Laying and Finish

The ceramic tile shall be laying in cement mortar (1:6) for floor which shall be at least 20mm in thickness with (1:1) cement sand slurry and in cement mortar (1:4) for wall which shall be at least 12 mm in thickness with (1:1) cement sand slurry joint shall be kept straight and small as possible. The joint filler should be of colour & brand specified by the Consultant/Employer.

A8.6. Granite Works

18 - 20 mm thick granite laid with cement sand mortar (1:6) or (1:4) as specified in drawing. In floors granite slope shall be done for draining wash water, including polishing to smooth glazed surface all complete.

a. Materials

It **shall** be of good quality having smooth, hard surface, regular shape, sizes and uniform thickness of good appearance, and of straight edge. It shall be free from cracks and other defects. The colour and size shall be as per instruction of the Consultant/Employer. Sample of Granite to be used shall be submitted to the Consultant/Employer and his approval shall be taken before bulk purchase. All the marble supplied shall conform to the approved samples in all respect.

b. Proportion

Cement Sand Mortar (1:6) 1 Part cement; 6 parts sand as per specification for floor. **Cement** Sand Mortar (1:4) 1 part cement; 4-part sand as per specification for wall.

c. Laying and Finish

The Granite shall be laid in cement mortar (1:6) or (1:4) for floor, which shall be at least **20** mm in thickness with cement paste. Joint shall be kept straight and small as possible. The joint filler should be of appropriate colour as approved by the Consultant.

A8.7. Porcelain Tile Flooring Work

Porcelain tile in floor, skirting laid with cement sand mortar (1: 6) in proper slope for draining wash water, including polishing to smooth glazed surface all complete in Sqm.

a. Materials

Porcelain tile

It shall be of good quality having smooth, hard surface, regular in shape, sizes and uniform thickness, of good appearance, and of straight edge. It shall be free from cracks and other defects. Porcelain tile may be from Chinese Company or equivalent. The colour and size shall be as per instruction of the Consultant/Employer. Sample of tile to be used shall be submitted to the Consultant/Employer and his approval should be taken before bulk purchase. All the tiles supplied shall conform to ISO 10545 and approved samples in all respect and shall meet the following specification.

Technical Features	Specification	Standard
Water Absorption	ISO 10545 – 3	<0.5%
Bending Strength	ISO 10545 - 4	>32 N/mm^2
Abrasion Resistance	ISO 10545 - 6	<175 mm^3
Linear Thermal Expansion	ISO 10545 - 8	<9 x 10^{-6} K^{-1}
Chemical Resistance	ISO 10545 – 13	> Class 3
MOHS / Surface Hardness	EN 176	>6

b. Proportion

Cement Sand Mortar (1: 6) 1 part cement; 6 parts sand as per specification.

c. Laying and Finish

The Porcelain tile shall be laid in cement mortar (1: 6), which shall be at least 20 mm in thickness. Joint shall be kept straight and small as possible. The joint filler should be appropriate colour.

A9. PAINTING

Inside and outside painting with approved colour and paints to give uniform colouring after rendering the surface clean and moist.

Inside and outside colouring with Plastic Emulsion, Silicone Paint, Enamel & French polish in two coats with primer coats all complete, in Sq.m.

a. Materials

All the painting materials shall be only ready mixed type in sealed tins of approved makes. Paints shall be obtained from Asian Paints or Jenson & Nicholson Paints. In case of washable distemper, enamel or cement paint and coat sill for Silicone base paint.

b. Delivery and Application of Paints

All materials required for the work are to be delivered to site in their containers with seal, etc. unbroken and are to be marked with manufacturer's name and trademarks and a description of contents and colour.

Paints shall be mixed and applied strictly in accordance with the manufacturer's instructions and with the approval of the Consultant. All materials shall be stored at the site of work. All paints shall be applied by spray.

c. Addition to Paints

The only addition, which will be allowed to be made locally, shall be as per manufacturer's written instructions and as approved by the Consultant/Employer.

d. Preparation

All surfaces shall be sand papered and cleaned.

The surface for plaster of Paris shall be patched up with thick paste of the same primer and smoothed after drying. Uneven surface of the premiered surface shall be filled with putty made of chalk power with cement primer. The surface so prepared will be sand papered & thus surface is prepared for the finishing paints.

In case of timber having knots and nail holes, they should be filled with stopping and knotting materials. The knotting material shall consist of pure shellac dissolved in methylated sprit. For stopping, putty shall be used. The stopping shall consist of two parts of Whiting (Power chalk), one part of white lead mixed together in doubled boiled linseed oil and well kneaded. The surface thus treated shall be allowed to dry up and then sand papered, or a ready-made approved putty may be used.

e. Application

After preparing the surface, the single coat of paint is first applied with the spray. The first coat so applied will be mildly sand papered to remove the remaining uneven surface. The final coat will then be applied with spray.

A10. FALSE CEILING

Providing and fixing suspended false ceiling, which include providing and fixing G. I. perimeter channels of approved quality with paper tape & pairs coat finishes, all complete in Sqm.

a) Materials

i. Gyp board

ii. E-board

iii. G.I Channels

b) Framing

Farming shall be fitted of G. I. perimeter channels of size 0.55 mm thick having one flange of 20 mm and another flange of 30 mm and web of 27 mm along with perimeter of ceiling, screw fixed to RCC or brick wall with the help of nylon sleeves and screws, at 610 mm Centres. Then suspending G. I. intermediate channels of size 45mm, 0.9 mm thick with two flanges of 15mm each with the help of a level adjuster made of zinc alloy 50 x 25mm as per drawing or instruction of consultant from the soffits at 1220mm Centre with M. S. flat 25 x 3 mm thick shall be fixed to soffits with G. I. cleat and metal expansion fastener. Ceiling section of 0.55 mm thickness shall have knurled web of 51.5 mm and then shall be fixed to the intermediate channel with the help of connecting clips and in direction perpendicular to the intermediate channel at 457mm Centres.

c) Fixing

After framing work is completed, fixing of 12.5mm tapered edge Gyp board (conforming to IS – 2095 – 1982) or E-board as specified instruction of the Consultant shall be screw fixed to frame at level as per drawing with 25mm drywall screws at 230mm Centre. Screw fixing shall be done mechanically either with screwdriver or drilling machine with suitable attachments. Finally, the boards shall be jointed and finished so as to have a flush look. This shall include filling and finishing the tapered and square edges of the board with jointing compound, paper tape and two coats of primer suitable for Gyp board or E-board (as per recommended practices of India Gypsum or E-board or Equivalent).

A11. GYPSUM BOARD PARTITION

Providing and fixing gypsum board partition, which include providing and fixing G. I. channels of approved quality with paper tape & pairs coat finishes, all complete in Sqm.

a) Materials

i. Gyp board

ii. E-board

iii. G.I Channels

b) Framing

Farming shall be fitted of G. I. Vertical studs (48/70 mm) fixed in floor and ceiling channels (50/72 mm) wide to provide a strong partition (75/97 mm). Fixing shall be done by self-taping screws, with vertical studs being at 610mm intervals as per drawing or instruction of consultant

c) Fixing

After framing work is completed, fixing of 12.5mm tapered edge Gyp board (conforming to IS – 2095 – 1982) or E-board as specified instruction of the Consultant shall be screw fixed to frame at level as per drawing with 25mm drywall screws at 230mm centre. Screw fixing shall be done mechanically either with screwdriver or drilling machine with suitable attachments. Finally, the boards shall be jointed and finished so as to have a flush look. This shall include filling and finishing the tapered and square edges of the board with jointing compound, paper tape and two coats of primer suitable for Gyp board or E-board (as per recommended practices of India Gypsum or E-board or Equivalent).

Technical Specifications - ELECTRICAL INSTALLATION WORKS (As applicable)

B1. Scope:

The works covered shall include supply of all materials, labour, equipment and services in connection with the Electrical works complete as indicated. The contractor shall consult drawings, bill of quantities and specification all together, which gives the total scope of works.

B2. Rates:

The rate quoted in the tender shall include all charges of materials, installation, testing, commissioning, labour, tools and equipment, shed for material store, transferring all material from place of availability to the site, all taxes, contingencies, breakage, wastage and maintenance of installation for 18 months. The rate in the original contract shall determine the values of the extra work where such extra work is of a similar nature and has been executed under similar conditions. Wherever the extra work is not of a similar nature, the rate for the same shall be determined prior to the execution of work and get approved by the consultant.

B3. Quantities:

All quantities mentioned in the bill of quantities are not actual and the contractor will get payment according to measurement of actual work. The schedule of quantities is liable to alteration by deletion or addition as required.

B4. Drawings:

The drawings provided are design drawings and generally are diagrammatic. They do not show offsets, bends, pull box, junction box, which may be required for the installation. The contractor shall follow the drawings as closely as possible and shall provide necessary bends, pull box etc. The contractor shall prepare and submit for approval detailed shop drawings of all installations not detailed on the drawings provided. Some modification in design drawing can be done during the Construction time in order to overcome practical difficulties provided the employer approves the modification.

B5. Cutting and patching:

Cutting and patching required for the proper installation and completion of works including plastering, masonry work, concrete work and painting shall be done by the contractor himself and skilled labour shall be provided for the same.

B6. Site Condition:

The equipment and materials to be installed should be suitable for the site conditions.

It is estimated that the maximum temperature at site will be 400C.

B7. Main Control Panel:

B7.1. The Main Control Panel shall be indoor type, totally enclosed made from 16 SWG heavy gauge mild steel sheet, dust and vermin proof suitable for wall mounting/ pad mounting. The steel sheet should undergo acidization and phosphatising process before two coats of red oxide primer are applied, then two final coats of enamel paint of approved colour shall be applied.

B7.2. The bus bar shall be made from highly conductive electrolytically pure copper bar strips of sufficient cross-sectional area so that maximum current density of 1.2 amps per sq. mm. shall not be exceeded. The neutral bus bar shall not be less than 50% of the phase bus cross section. The main bus bars shall be single length without joint up to the incomer MCCB. The bus bars shall be sufficiently supported by insulator so that insulation resistance shall not be less than 20 mega ohms.

B7.3. Arrangement shall be made at the bottom of the control panel for receiving incoming cable. Space for outgoing cables shall be properly designed and managed as per requirement.

B7.4. The interconnection of cable to the bus bars, MCCB shall be done with heavy duty crimping type chromium plated copper double compression cable shoe of suitable size.

B7.5. The MCCBs shall have a breaking capacity of 25 kA or higher at 400 volts for incoming circuit and 15KA or higher for outgoing circuits. The circuit breaker shall be operated by a toggle type handle and shall have a quick make, quick break trip free mechanism. The circuit breaker shall be of inverse time and instantaneous trip type, with static trip release. A push trip shall be provided on the cover to test the MCCB mechanically. The 'on', 'off' and 'trip' positions shall be clearly marked on the enclosure.

B7.6. The connections from the main bus bars to the incoming as well as outgoing MCCBs shall be done by copper strips having sufficient cross-section.

B7.7. All the contact surfaces in copper bus bars and strips shall have coating of silver by electroplating.

B7.8. The gap between two MCCBs shall not be less than 40 mm.

B7.9. All the outgoing MCCB shall be marked by the tag covered by transparent PVC pocket permanently fixed on the inner cover.

B7.10. The bus bars shall be covered by heat shrinkable PVC sleeve and the bus bar chamber shall be covered by a protecting transparent acrylic sheet.

B8. Floor Distribution Board:

B8.1. The Main Distribution Board shall be indoor type, totally enclosed made from 16 SWG heavy gauge mild steel sheet, dust and vermin proof suitable for wall mounting. The steel sheet should undergo acidization and phosphatising process before two coats of red oxide primer are applied, then two final coats of enamel paint of approved colour shall be applied.

B8.2. The bus bar shall be made from highly conductive electrolytically pure copper bar strips of sufficient cross-sectional area so that maximum current density of 1.2 amps per sq. mm. shall not be exceeded. The neutral bus bar shall not be less than 50% of the phase bus cross section. The main bus bars shall be single length without joint up to the incomer MCCB. The bus bars shall be sufficiently supported by insulator so that insulation resistance shall not be less than 20 mega ohms.

B8.3. Arrangement shall be made at the bottom of the control panel for receiving incoming cable. Space for outgoing cables shall be properly designed and managed as per requirement.

B8.4. The interconnection of cable to the bus bars, MCCB shall be done with heavy duty crimping type chromium plated copper double compression cable shoe of suitable size.

B8.5. The MCCBs shall have a breaking capacity of 15 kA or higher at 400 volts for incoming circuit and 10 KA or higher for outgoing circuits. The circuit breaker shall be operated by a toggle type handle and shall have a quick make, quick break trip free mechanism. The circuit breaker shall be of inverse time and instantaneous trip type, with static trip release. A push trip shall be provided on the cover to test the MCCB mechanically. The ‘on’, 'off' and ‘trip’ positions shall be clearly marked on the enclosure.

B8.6. All the contact surfaces in copper bus bars and strips shall have coating of Silver by electroplating.

B8.6 The gap between two TP MCCBs as well as that of TP MCBs shall not be less than 40 mm and 30 mm respectively**.**

B8.7 All the outgoing MCB shall be marked by the tag covered by transparent PVC pocket permanently fixed on the inner cover.

B8.8 The bus bars shall be covered by heat shrinkable PVC sleeve and the bus bar chamber shall be covered by a protecting transparent acrylic sheet.

B9. Underground Cable:

The underground LT cable shall be laid in a trench 1m below the general ground level. The bottom of the trench shall be levelled, and brick trench shall be made as per drawing. The cable shall be laid over the dry sand and covered by removable brick top cover. The inside cavity of the trench shall be completely filled by dry sand. Wherever cable crosses road or drains, GI sleeves pipes of approved diameter shall be provided.

B10. EARTHING

Earthing shall be carried out as per drawing with 600 mm x 600 mm x 3.14 mm copper plate. The earth resistance of the earthing electrode shall not exceed 50 ohms.

B11 Distribution boards (DB):

Sub distribution board shall be made with 16 SWG mild still sheet cubical, concealed mounting with double cover having openable hinges and locking arrangement. The mild steel sheet shall be painted with two coats of red oxide primer, and the two final coats of steel gray color enamel. The bus bar used shall be made from highly conductive electrolytically pure copper bar strips of sufficient cross-sectional area so that maximum current density of 1.2 Amp/sq mm shall not be exceeded. Neutral bus bar shall not be less than 50 % of the phase bus cross section. The interconnection of cable inside SDB shall be done with crimping type cable shoe of appropriate size. The incomer MCCB shall have breaking capacity of 10 kA or higher at 400 volts and the outgoing MCBs shall have breaking capacity of 9 KA or higher at 230 volts. All the outgoings MCB shall be properly marked on the inner cover.

B12 Wiring and conduiting:

B12.1 All wiring and conduiting of cable shall be concealed inside ceiling slab and wall.

B12.2 All the wiring conductors shall be of soft drawn annealed copper with HD insulation rated for 600 Volts. The cable shall be drawn in PVC conduits of size mentioned in the bill of quantity. The minimum wall thickness of HDPE conduit shall be 2 mm.

B12.3 Maximum 7 nos. of 2.50 sq. mm PVC insulated copper wire along with an earth wire shall be allowed through a 20 mm internal dia. PVC conduit and maximum of 5 nos. 4 sq. mm PVC insulated copper wire along with an earth wire shall be allowed through a 20 mm internal dia. HDPE conduit.

B12.4. All the HDPE conduits shall be single length without joint except in the junction box and pillbox. Single conduit length above 15m shall be provided with a conveniently located pull box. Pull box also shall be provided at the sharp bending of conduit.

B12.5. All wiring conductors shall be single length without joint except in the junction box. No cable joint shall be allowed in the pull box.

B12.6. PVC insulated wire of different colours shall be used so that phases and neutral wires can be distinguished. THE COLOR CODE IS TO BE FOLLOWED STRICTLY.

B12.7. Junction box for branch circuit shall not be less than 6"X 4"X 2" made of 18SWG GI metal sheet. The box shall be installed 180 mm below the ceiling and shall be covered by 8"X 6" MS plate (18 SWG) with enamel of colour matching with the wall.

B12.8. The metal box for switch, Bell Switch, Alarm shall be made of 18 SWG GI sheet, while shall be fixed at the height of 50" (centre) from the finished floor.

B12.9. The metal box for Power, TV, Telephone, Alarm shall be made of 18 SWG GI sheet, while shall be fixed at the height of 14" (centre) from the finished floor.

B13. Standard Makes:

Notes:

MCCB	Mitsubishi (Japan) / Terasaki (Japan)/ Hitachi/Siemens
MCB	Legrand / Clipsal /Havells
Wiring cable	Janata/Prakash/Nepal wire NS approved
Communication Cable	Jelly filled (Singapore)
Power Cable	Prakash cable/ Janata cable/ Nepal cable
Light switch	Modular Legrand/Crabtree/Hausmann

The bidder must get approval by the Employer/ consultant, for the samples before installation.

Switch socket	Modular Legrand/Crabtree/Hausmann
Fluorescent tube light fixtures	GE/CG/Havells/Bajaj/SCT
Incandescent light fixtures	GE/CG/SCT/Havells/Decon
Ceiling fan / exhaust fan	Crompton Greaves / Bajaj / Havells
Telephone/TV/Computer sockets	Modular Legrand/Crabtree/Hausmann
IDC Connector	Krone
Electrical Panel Board Fabricators	MK Metal / Hyonjan Electric
Transformer	Transweld/NEEK
Smoke, Heat Detector	System Sensor
Manual Call Point	KAC (UK)
Hooter	Siemens/CTEK

Samples of the items whose standard make are not indicated shall be submitted and get approved by the Employer/ consultant before installation.

The Bidder shall furnish proper certification in original or authentication letter from the concerned manufacturer or its distributors confirming the genuinely of the materials being offered. Failing to submit such certification or letter would automatically reject the material.

B13.1. CEMENT

The contractor will have to make his own arrangement to lift the cement from the go down to the site.

i. The weight of cement in sealed bags shall be considered as 50 Kgs. Being equivalent to 35 litres (1.2 Cft.) in volume.
ii. Cement shall be stored in weatherproof shed with raised wooden plank flooring to prevent deterioration by dampness or intrusion by foreign matter.

B13.2. SAND

Sand shall be clean, free from salt, clay, loam, shells, vegetable matter and fit for use in the opinion of the Consultants.

B13.3. COARSE AGGREGATE

Shall be angular, tough, sharp and well graded stone metal from approved source. If directed, the metal shall be washed.

B13.4. BRICKS

Bricks shall be local best quality obtainable and shall be table moulded, well burnt, but not over burnt and shall be free from cracks, chips, flaws and stones. It shall not absorb water more than 20% of its own weight when dry.

B13.5. CEMENT MORTAR

Shall be of the proportion specified in the particular item in the schedule of quantities. Sand shall be measured in suitable measuring boxes and correct quantity of cement shall be added. The materials are mixed dry on a clean platform. Clean water is then added and mixed thoroughly. It shall be prepared in such quantity as can be readily used up. Mortar, which has partially set shall under no circumstances re-tempered by mixing with additional materials or water.

B14. INTERNAL & EXTERNAL DRAINAGE (As applicable)

B14.1. EXCAVATION FOR UNDERGROUND DRAINAGE

a) Trenches for the pipes shall be excavated to lines and levels as directed. The bed of the trench shall be truly and evenly dressed throughout from one change of grade to the next.
b) The gradient is to be set out by means of boning rods and should the required depth be exceeded at any point; the trench shall be refilled by means of cement or lime concrete of the specifications of bed concrete at the Contractor's own expense.
c) The bed of the trench, if in soft or made-up earth, shall be well watered and rammed and depression thus formed shall be made or other suitable materials as directed by the Consultants without any extra cost.
d) If the rock is met with, it shall be removed to 6 inches (150 mm) below the level of the pipe and the trench refilled with concrete or sand or other suitable materials as directed by the Consultants without any extra cost.
e) The trench will be kept free from water. Shoring and timbering shall be provided wherever required.
f) The trench width shall be nominal diameter of the pipe plus 15" (375mm) but it shall not be less than 21 inches (525 mm).

B14.2. PROTECTION OF EXISTING SERVICES

a) Refilling

Refilling in trenches for pipes shall be commenced as soon as the joints and concrete have been passed. The refilling on the top and around the drain shall be done with great care and in

such a manner as will obtain the grates amount of compactness and solidity possible. For this purpose, the earth shall be laid in regular amount of compactness and solidity possible. For this purpose, the earth shall be laid in regular layers of 6 inches, (150 mm) watered and each layer rammed.

b) All surplus earth shall be disposed of as directed by the Consultants.

B14.3. CONCRETING

All pipes shall be laid on a bed of 6 inches (150 mm) concrete with one part of cement, four parts of sand and 8 parts of brick bars of 1 ½ inches (40mm) down gauge of stone metal properly consolidated. Concrete shall be laid to the full width of the trench and also in the haunches as per the standard drawing.

B14.4. MANHOLES & INTERCEPTING CHAMBERS

Masonry chambers shall be circular in plain (except when the depth is less than 3 – 0" (900 mm) in which case it shall be rectangular in plan with 3' – 0" x 1' – 6" (900 x 450) internal dimensions) and conical in shape with 21 inches (525 mm) dia. Opening at the top and internal dia. of 3' – 0" to 4' – 0" (900 x 1200) at the bottom upto a depth of 6 feet (2m) and shall be constructed in 9 inches (225 mm) thick brick masonry in 1:5 cement mortar, when the depth of the manholes etc. reaches upto 8 feet (2.50m) the first two feet depth of the masonry shall have a thickness of 14inches (400 mm). In case the depth exceeds 8 feet (2.50 m) to a depth of 15 feet, (4.5 m) the thickness of the masonry shall be 18 inches (450 mm) upto the first 3 feet (900 mm) to a f feet (1200mm) 14 inches (400mm) thick upto a depth of 4 feet (1.2) to 5 feet (1.5 m) and the rest shall have a thickness of 9 inches (225mm). The top opening shall have a diameter of 21 inches and the bottom internal diameter shall vary from 3 feet (900mm) to 6 feet (2m).

Manholes etc. shall be plastered from inside and outside in ¾ inch (20 mm) thick cement mortar 1:4 with smooth cement finish from the inside and rough finish from outside.

Manholes etc. shall be constructed in 1:3:6 plain cement bedding and shall have a minimum thickness of 6 inches (150mm) upto 6 feet (2m) depth and 9 inches (225mm) beyond 6 feet (2m) upto 15 feet (4.5m).

Proper cement concrete channels shall be provided at the bottom and the branch from the various pipes shall discharges in the chamber with a suitable slope.

The top manhole shall be provided with C. I. airtight frame and cover weighting from 2 cwts. In case of any damage to the covers due to traffic or any other reasons during the course of the projects, or any other reasons during the course of the project, or during the maintenance period, the same shall

be replaced immediately by the Contractor at his own cost. The frame and the cover shall be painted with Black Bitumen Anti-corrosive paint.

B14.5. LAYING AND JOINING OF S. W. PIPE

a) Laying

The pipes shall be carefully laid to the levels and gradients shown on the plans and sections with socket up the gradients.

b) Jointing

Spun yarn in neat cement wash shall be passed round the joint and inserted in it by means of caulking tool. More skein of yarn shall be added, and one part of sand shall be slightly moistened and must no account be soft or sloppy and shall be carefully inserted by head into the joint. The mortar shall then be punched, and more cement mortar then be punched and caulked into the joint and more cement mortar added until the space of the joint has been filled completely with tightly caulked mortar. The joint shall then be finished off nearly outside the socket at an angle of 45 degree.

B14.6. CURING

The joint shall be cured at least for seven days.

B14.7. Testing

All joints shall be tested to a head of 2 feet or water above the top of the highest pipe between the two manholes. Any joint found leaking or sweating shall be remade or embedded in 15 cms. thick layer of cement concrete 1:2:4 30 cms. in length and section re-tested.

B14.8. STONE – WARE GULLY TRAPS

Stoneware gully traps of specified sizes and quality as described earlier shall be fixed on 15 cms. thick and 70 cms. Square cement concrete of 1:4:8 bedding and the gully outlet to the branch drain shall be jointed similar to jointing of S. W. pipes. A brick masonry chamber of 30 cms x 30 cms. Internally shall be constructed in half brick masonry with 1:5 cement mortar and the space between the trap and the wall, filled up with 1:4:8 concrete, and the upper portion of the chamber finished internally with 1:3 cement mortar and finished with neat cement. The corners and bottom of the chamber shall be rounded off so as to slope towards the grating.

In addition to 15 cms x 15 cms, C. I. grating, the chamber shall have a C. I. cover with frame 30 cms x 30 cms. (inside) with mechanical seating faces shall then be fixed on the top of the brick masonry with cement concrete 1:2:4 and rendered smooth. The weight of cover shall not be

less than 4.53 kg, and that of frame 2.72 kg. The finished top of cover shall be left 4 cms. above the adjoining surface so as to exclude the surface water from entering the gully trap.

B14.9. HUME PIPE DRAINS

a. Pipes

Shall be reinforced and conform to relevant IS specification. They shall be new and perfectly sound, free form cracks, cylindrical, straight and of specified nominal diameter. Each pipe shall have one collar.

b. Trenches & Refilling

Shall be as described under S. W. pipes.

c. Concreting

No concreting is ordinarily, necessary. In case where the soil is made up or is very soft, concreting may be resorted to as described under stoneware pipe without any extra cost.

d. Laying & Jointing

The pipe shall be laid as described under stone ware pipe by placing the collar centrally over the joint.

These shall be free from cracks and other flows. The interior of pipes and fittings shall be clean and painted inside and outside with Dr. Angus Smith's solution of other approved anti-corrosive paint.

The access door fittings shall be of proper design so as not to form any cavities in which fifth may accumulate. Doors shall be provided with 1/8-inch (3mm) rubber insertion packing and when closed bolted, they shall be water right.

B15. C.I. SOIL, WASTE, VENT PIPES & FITTINGS

B15.1. CAST IRON

a. C. I. Pipes & Fittings

Cast Iron, Soil, Waste and Vent Pipes and Fittings shall be of heavy is preferred to sand cast soil pipes which to IS 1729. The standard weights and thickness of pipes are given below and tolerance upto 4% may however be allowed against these standard weights.

(IS: 3989 – 1967 for centrifugally sun soil type)

Nominal Dia.	Thickness	Overall weight 1.83 M Length	Internal dia. of Socket
50 mm	3.5 mm	8.5 kg	73 mm
75 mm	3.5 mm	12.7 kg	99 mm
100 mm	4.0 mm	19.2 kg	126 mm
150 mm	5.0 mm	35.5 kg	179 mm

Dia.	Thickness	Overall weight 1.83 M Length	Internal dia. Of Socket
50 mm	5 mm	11.41 kg	76 mm
75 mm	5 mm	16.52 kg	101 mm
100 mm	5 mm	21.67 kg	129 mm
150 mm	5 mm	31.92 kg	181 mm

b. Laying

The pipes shall be laid as described in the Schedule of Quantities and as shown on the Architect's drawing.

c. Joints

Joints shall be made as described under Water Supply.

Connections between main pipe and the branch pipe shall be made by using appropriate branch bends invariably with access doors for cleaning.

B15.2. LEAD CAULKED JOINTS

The annular space between the socket and spigot be first well packed in with spun yarn soaked in bitumen and dried, leaving 25 mm from the lip of socket for lead pipes, upto 100 mm dia. and 40 mm dia. depth for pipes of 150 mm dia. The joints may be headed by using proper leading rings or if they are not available, by wrapping a ring of hemp rope covered with clay round the pipe at the end of the socket, leaving a hole through which led shall be poured and molten lead free from zinc or tin and thoroughly fluid shall be poured and each point filled of one pouring. Before caulking the projecting, lead shall be removed by flat chisels and then the joint caulked round with proper caulking tools and a hammer of 1 to 1.5 kg in weight, in such a manner as to make the joint quite sound. The joint shall be left flush neat and even with the socket.

All such works shall be carried out with prior written approval from the Consultant and shall be carried out in the presence of the Consultant's representative.

B15.3. TESTING

All C. I. Pipes and Fittings including joints shall be tested by smoke test and left in working order after completion.

The minimum weight if lead in each joint shall be as follows:

1.	150 mm dia.	2.95 kg/joint
2.	100 mm dia.	1.90 kg/joint
3.	75 mm dia.	1.20 kg/joint
4.	65 mm dia.	0.70 kg/joint

The pipe work joint shall be approved gas tight or watertight as per deign requirement and shall be tested with smoke or water maintained for a period recommended by ISI. The acceptance criteria shall be as laid down therein.

B15.4. TRAP

a. General

Provide traps on all fixtures connected to the waste system, except for fixture having internal traps. All traps shall have a seal of not less than 40 mm dia. and not more than 100 mm dia. All traps shall have the same internal diameter as the fixture's waste outlet.

b. Exposed Traps

Exposed traps for fixtures shall be chromium plated cast brass per IS.

c. Intercepting Traps

Provide glazed stoneware sewer interceptor as indicated on the drainage drawings, with cleaning arm metal stopper chain. Encase in non-reinforced Portland cement concrete as above and as shown.

d. Gully Traps outside the Building

Provide stoneware gully traps of 225 mm x 150 mm size to receive 150 mm pipe and (150mm x 100mm) size to receive (100mm) pipe were shown for the waste pipes (before connecting to sewer).

e. Gully Traps Inside Building

Provide 150 x 100 mm size heavy cast iron sealed gully taps, extension piece, having single or double inlet as shown. Provide cast iron sealed cover for each trap secured with threaded gunmetal bolts and felt gaskets.

B15.5. PAINTING

All exposed C. I. pipes and fittings shall be painted to match the colour of the surroundings with 2 coats of flat / enamel paint over a coat approved primer. If directed, additional coats shall be given at no extra cost.

B15.6. LEAD PIPES

All lead pipes shall be hydraulic drawn and of equal substance throughout conforming to IS: 404 – 1962.

Weight and wall thickness of pipes shall be as under.

Nominal Diameter	Wall Thickness	Weight in kg / meter
32 mm	2.6 mm	1.28 kg
40 mm	2.6 mm	2.95 kg
50 mm	2.7 mm	5.07 kg
75 mm	2.7 mm	7.48 kg
100 mm	2.7 mm	9.88 kg.

When not supported on bearers, all lead pipes shall be supported by strong lead tracks at least 40 mm wide soldered on to the pipe at suitable intervals.

B15.7. WIPED SOLDER JOINTS

All joints of lead pipes shall be wiped solder joints as directed below:

The pipe ends to be jointed shall be cleaned with a wire brush and freed from oxide, if any Chalk shall then be rubbed to kill greasy nature of the lead. A fine shaving of lead shall be removed from this length with shave hook, hallow shall then be moved from the prepared surface. The molten solder, and alloy composed of 3 parts of tin and 7 parts of lead, shall be poured in & thin stream from a ladle moved in an elliptical direction over the joint position including a portion of the soil pipe at each end beyond the mark. When sufficient solder has been poured, the joint

shall be wiped with a pad of wiping cloth with long continuous movements in one direction only, so as to leave a nearly formed elliptical shaped joint. Surplus solder remaining on the joint shall be removed.

The

S. No.	Size of pipe No.	14 Length of Joints	
		Minimum	Maximum
1.	15 mm	60 mm	70 mm
2.	20 mm	65 mm	70 mm
3.	25 mm	70 mm	75 mm
4.	32 mm	70 mm	80 mm
5.	40 mm	70 mm	80 mm
6.	50 mm	75 mm	90 mm
7.	75 mm	75 mm	90 mm
8.	100 mm	80 mm	90 mm

joints shall be water – tight and shall be free from tears, burrs, strings, rib ands or droppings.

B15.8. LEAD PIPE CONNECTIONS

The joints lead pipe and C. I., or stoneware pipe shall be made as under:

a. One end of brass thimble or ferrule shall be slipped into or over the lead pipe and jointed to it by means of a wiped solder joint. The other end of the ferrule shall be inserted into the socket of the C. I. or stoneware pipes. In the case of the latter, with cement mortar as in stoneware pipe drains.
b. The joints between outgo of a W. C. pen and a lead pipe shall be made as under.
c. The lead shall be slipped into a brass socket and jointed to it by a wiped solder joint. The outgo of W. C. pan shall then be inserted into the socket and jointed by using cement mortar as in stoneware drains.

B15.9. PAINTING

All exposed lead pipes shall be painted as in section ’e’ of C. I. soil, waste, Vent pies and fittings.

B16. INTERNAL WATER SUPPLY

B16.1. G. I. PIPES AND FITTINGS

The pipes shall be of the class specified in the schedule of Quantities and shall be of galvanized steel welded or seamless, screwed and socketed and shall conform to IS 1239. They shall be manufactured by a firm of repute. All fittings shall be malleable Iron galvanized fittings of approved best Indian make.

The details of pipes regarding nominal bore thickness and weights are given below:

Nominal Bore	Approx. Outside	Screwed and socketed wt. Per meter			Screwed and Socketed Meter per kg.		
m.	dia.	Light	Medium	Heavy	Light	Medium	Heavy
15	21.3	0.961	1.23	1.46	1040	813	685
20	26.9	1.42	1.59	1.91	704	629	524
25	33.7	2.03	2.46	2.99	493	407	334
32	42.4	2.61	3.17	3.87	383	316	258
40	48.3	3.29	3.65	4.47	304	274	224
50	60.3	4.18	5.17	6.24	239	193	160
65	76.1	4.92	6.63	8.02	169	151	125
80	88.9	6.98	8.64	10.3	143	116	98
90	101.6	8.92	9.90	11.8	112	101	84.7
100	114.3	10.2	12.4	14.7	98	80.6	68
125	139.7		16.7	18.3		59.9	54.6
150	165.1		19.8	21.8		50.5	45.9

Note: The above weights are for black pipes and theoretical weights of galvanized pipes are 6% higher.

B16.2. LAYING & FIXING

Where pipes have to be cut, or rethreaded ends shall be carefully filled out so that no obstruction to bore is offered.

For internal work all pipes and fittings shall be fixed truly vertical and horizontal, either by means of standard pattern holder bat clamps keeping the pipes of 12mm clear of the wall wherever or concealed as directed.

For external work C. I. pipes and fittings shall be laid in trenches. The width of the trench shall be the minimum shall width required for the working. The pipes laid underground shall not be

less than 60cms (600 mm) from the ground level. They shall be painted with hot asphalt and wrapped with hessian cloth and again painted with coats of hot asphalt (Pipes embedded in masonry / concrete shall be treated similarly). They shall be surrounded with 15cms thick sand of approved quality all around. The work of excavation and filling shall be done as directed.

B16.3. PAINTING

All exposed pipes and fittings shall be painted with a 2 coats of approved shade flat / enamel paint over a paint shall be given without any extra cost.

B16.4. TESTING

All C. I. pipes and fittings shall be tested in an approved manner to ensure that pipes have proper threads and that proper materials such as white lead and hemp have been used in joining. All leaky joints must be made leak proof by tightening or re-doing at Contractor's expense.

B16.5. BRASS WATER FITTINGS

All brass fittings shall be of approved quality and design shall generally comply at latest IS, Specifications. They shall be fixed in the pipeline in a workmen like manner and care shall be taken to see that joints between fittings and pipes are made leak proof. The fittings and joints shall be tested in an approved manner to ensure that the joints are leak proof. The defective fittings and joints shall be repaired or redone / replaced.

B17. INSULATION TO HOT WATER PIPES

B17.1. INTRODUCTION

a. General:

This specification cover applying insulation to hot water piping. All tests shall be completed, and system approved before the insulation is applied to piping. Apply all insulation in accordance with manufacturer's recommendations.

b. Material:

Size of pipe	**Thickness of tube**
Up to 200 dia.	6mm thick
20 mm dia. or more	9mm thick

B17.2 SPECIFICATION

a. Clean the pipes with wire brush rendering the pipes free from rust and greasy materials.

b. Apply a coat of heat-resistant bituminous primer on pipes.

c. Fix 25mm dia. thick glass wool and wrap with wire mesh, butting all joints longitudinally and circumferentially and the down with 22 gauge lacing wire.

d. Cover with magnesium hard setting compound evenly and cylindrically and finished with cement plaster.

e. Apply two coats of Bituminous Asphalt paint water barrier.

f. All fittings including valve bodies and bonnets, unions, flange, expansion joints and flexible connection shall be covered with insulation or insulating cement to a thickness equal to the adjoining pipe insulations thickness.

B18. SANITARY FIXTURES & FITTINGS (As applicable)

B18.1. GENERAL

Sanitary ware, accessories and C. P. fittings shall be of the best quality, approved by the engineer. Wherever particular makes are mentioned, the choice of selection shall remain with the Consultants.

All fixture and fittings shall be provided with all such accessories as are required to complete the item in working condition whether specifically mentioned in the Specifications, Bill of Quantities, or drawings. Accessories shall include proper fixing arrangement, brackets, nuts, bolts, screws and required connections pieces.

Fixing screws shall be half round head chromium plated brass screws with C. P. Washers where necessary.

Porcelain Sanitary ware shall be glazed vitreous China of best quality free from wraps, cracks and glazing defects. All ware shall be white unless otherwise given in the Bill of Quantities. Colour of sanitary ware, when specified shall be selected by the Engineer. Fixtures shall conform to IS. 2556 – 1967 and latest revisions.

Sinks for kitchen shall be stainless steel, double bowl and adjustable mixer type or as specified.

Chromium plated or brass oxidized fittings shall be cast brass suitably finished & rendered fittings of the best quality approved by the Engineer.

All fittings and fixtures shall be fitted in a neat workmanlike manner true to level at heights shown on drawings and in accordance with the manufacturer's recommendations. Care shall be taken

to fix all inlet and outlet pipes at correct positions. Faulty locations shall be made good and any damage to the finished floor, tiling or terrace shall be made good by the Contractor at his cost.

When directed, contractor shall fix fixture and accessories in a sample room for the approved of the Engineer. Sample room fixtures may be reused on the works if undamaged, but no additional payment for fixing or dismantling, shall be admissible.

Commissioning and Testing

Before commissioning and testing of fixture, contractor shall ensure that all soil waste stacks and drainages system are connected to the respective manholes and the outfalls sewer. He shall also ensure that the water supply system has been commissioned and tested.

Fixture shall be cleaned, and all debris and dirt removed. All stickers, levels etc. shall then observed for any leakage or drip at inlet and outlet connections. The rate of flow for each fixture shall be adjusted by control valve. All defective parts shall be replaced and retested.

On satisfactory testing and commissioning of the fixtures, contractor shall clean all fixtures and accessories by a suitable detergent and hand over in the absolutely clean and usable condition.

B18.2. WATER CLOSETS

a. Indian W. C. Set

Indian W. C. pan with integrated footrests shall be Orissa type as specified in the Bill of Quantities. Each Indian W. C. shall be provided with in 100mm dia. Cast iron or porcelain ‘p’ or ‘s’ traps with or without vent. Cistern shall be level porcelain of approved brand and quality.

Fixing: The W. C. pan shall be laid in floor slope towards the pan a workman like manner care being taken not to damage the pain in the process of fixing. If
damaged in any way, it shall be replaced at no cost to the Employer. The pan shall be fixed on a proper base of cement concrete 1:2:4 mix (1 cement: 2 coarse sand 4 stone blast 20mm nominal size) taking care that cushion is uniform and even without having any hollows between the concrete base and pan. Joint between the pan and finished floor shall be neatly done and no hair cracks shall be visible. Joint to HDPE waste line shall be as detailed.

b. European W. C. Set

European W. C. Set shall be of white vitreousness quality, double symphonic close ‘p’ or’ ‘s’ trap with 12 lts. Capacity porcelain low level cistern brackets complete in all respects. The W. C. and cistern shall be free from cracks, crazes, blisters and shall have smooth surfaces.

Seat and Lid: Shall be of solid Bakelite “ADMIRAL R EQUIVALENT” make and fitted exactly on the rim of the W. C. with C. P. brass hinges, rubber buffers and C. P. brass nuts.

Angle Valve: Shall be of 12.7mm dia. C. P. brass with inlet connection of required length, with unions and C. P. brass cap. The connection between angle valve and supply line laid in chase shall be made in a manner so that the union is flush with finished face of the wall and no threaded portion of the angle valve or supply line is visible.

Fixing: W. C. pan shall be fixed to wall with C. P. brass nuts bolted onto holding bolts of 250 mm as per the manufacturer’s specifications. A proper clearance between the pan & finished floor shall be maintained for ease of cleaning & maintenance. A continuous 6” x6” RCC horizontal runner at the correct height shall be incorporated into the mounting wall, all along the WCC compartments as directed, to cut as the mounting arrangement for the wall hung WCs.

i. The central axis of the pan shall be perpendicular to the finished face of wall on which the direct flush valve is fixed.
ii. The Outlet of the pan shall be centrally placed in the socket of HDPE pipe with a uniform space around for jointing, Jointing shall be done with butt welding, cement and water proofing compound and made watertight.
iii. The distance between Centre line of outlet of W/C. pan and finished wall face shall be so adjusted as to rest squarely against the finished wall face.

Measurements: Shall be by numbers.

Rates: Shall include the cost of all materials and labour involved in all the operations described above.

B18.3. URINALS AND PARTITIONS

a. Urinals

Urinals shall be lipped type of size 465 x 355 x 265 mm or large type of size 610 x 380 mm or stall type as specified in the Bill of Quantities.

Each lipped type urinal (large or small) shall be provided with one 32 mm dia. Chromium plated brass bottle trap with pipe to wall and wall flange. Small urinals shall be provided with one C. P. reducer to receive the flush pipe stall, and large urinals shall be provided with chromium plated spreader and 32mm C. P. waster as recommended by manufacturer.

Angle Valve:

Shall be of 12.7 mm C. P. brass with inlet connection required length with unions and C. P. brass cap.

Flush Pipe:

Shall be of C. P. brass 25 mm dia. Main with 12.7mm dia. Distribution pipes of required length complete with C. P. brass clamps, tees, crosses, bends, with unions, spreaders etc. of approved make.

Bottle Trap:

Shall be 38 mm cat C. P. brass type with wall discharge pipe of required length with flange. Discharge pipe shall be connected to G. I. or HDP water pipe in chase in a manner so that the flange is flush with finished face of wall.

Waste:

Shall be dia. C. P. brass type waste.

Fixing:

Urinals shall be fixed to wall by connected hangers' brackets, C. P. screws as required and recommended by manufacturers.

Each range of urinals shall be provided with an automatic flushing cistern with cover of vitreous China with brackets as specified. The size of the cistern, main flush pipe and spreader pipes shall be as follows:

No of Urinals	Capacity	Size of mail flush pipe	Size of branch pipe	Size of dims. Pipe mm
One	5	-	-	15
Two	10	20	-	15
Three	10	25	-	15
Four	12.5	25	20	15

Painting

The brackets shall be painted with 2 coats of white synthetic enamel paint of approved manufacture over and including a priming coat or red lead.

b. Urinal Partitions.

i. Porcelain Partitions

Porcelain Urinal partition shall be large size of white vitreous China 1st quality. These shall be free from any cracks, crazes etc. and shall have smooth surfaces.

ii. Marble Partitions

Marble partitions shall be of 1" or 1 ½ thick approved quality. Partitions shall be required size and shall be embedded 5" in wall with cement concrete 1:2:4 Marble shall be all corners and edges shall be rounded. These shall conform to the Specifications for Civil Works.

iii. White Glazed Channels

White glazed channels shall be white vitreous China block channel and shall include special bands, outlets, etc. Channels shall be fixed in proper slope over 1" layer of cement mortar 1:3. Joints shall be grouted with white cement.

iv. Chromium Accessories

Chromium plated accessories shall be heavy type fixed to wall by C. P. screws. Fittings e.g. coat, timber holders, liquid soap holder shall be of "Lotus" brand or equivalent approved.

Fixing: These shall be fixed to wall with coach screws or as directed by the Engineer.

B18.4. LAVATORY (BASINS)

Shall be white vitreous China of 1st quality with three tap holes or with single tap hole, as crazes, blisters and shall have smooth surfaces. They shall be mounted units with the heavy C. P. bottle below. Under no condition shall any pedestrial be used as the story below the basin must be completely uncluttered by and pedestrail or other object for case of cleaning and maintenance. Hindustan Twyfors or equivalent.

Mixing Fittings: Shall be 12.7 mm dia. C. P. brass with modern head.

Angle Valve: Shall be 12.7 mm dia. C. P. brass with 12.7 mm dia. C. P. copper supply pipe of 610 mm length and C. P. brass cap.

Waste: Shall be 32mm dia. C. P. brass heavy type, with solid rubber plug and ball chain.

Fixing: The basin shall be supported on a pair of C. I. brackets cantilevering from wall faces as directed by the engineer. There shall not be any gap between top edge of the basin and finished face of wall.

B18.5. BATHROOM FITTINGS As applicable

a. Mirror

Mirror shall be 5.5 thick glass of imported quality shall be free from bubbles, ripples or any other defects. The glass shall be uniformly silver plated at the back. Silvering shall have and uniform protective coating of red lead paint.

b. Towel Rail

Towel Rail shall be heavy C. P. brass or oxidized bronze as approved by the Engineer.

Fixing: Brackets shall be fixed to wall by means of C. P. brass screws to expansion shields firmly embedded in the wall or as directed by the Engineer.

c. Hooks

Hooks shall be C. P. brass 'BILLMAT' equivalent make as shall be approved by the Engineer.

Fixing: Shall be same as for towel rail.

Paper Holders

Toilet Paper Holders shall be white vitreous China recessed or semi-recessed type unless mentioning bill of quantity. These shall be of 1st quality, free from cracks and crazes etc.

Fixing: These shall be fitted in recess in masonry on 30mm. Thick cushion of cement concrete 1:2:4 and jointing to masonry with the white cement or with approved operations.

d. Soap Dish

Soap Dish shall be of vitreous China or heavy type C. P. unless otherwise mentioned in the Bill of Quality.

e. C. P. Fittings

All mixing fittings, additional bib cocks, shall be of the best quality heavy pattern approved by the Engineer and conforming to IS: 781.

All C. P. fittings shall be fixed in a workman like manner and shall not tool marks and scratches. All valves shall carry identical C.P. brass screws, where required.

f. Shower Sets

Shower set shall comprise of one or two 15mm dia. C.P. conceal stopcocks, 15 mm inclined shower arm with wall flange and 60 mm bud shower rose with swivel joint. Concealed stopcocks shall be fixed on one level 4' above finished floor level.

g. Miscellaneous White Glazed Fittings

White glazed fittings, e.g., toilet paper holders, soap dishes, shelves, partitions, etc. shall be of white glazed vitreous China of the same colour and shade as that of the main fittings. All fittings shall be fixed in wall in a neat workmanship manner. Recess in wall, where required shall be provided. All fittings shall be fixed with C. P. brass screws, where required.

h. Floor Traps and Gratings

Floor traps shall be cast Aluminium alloy of HCI or HDP as per bill of quantities with a water seal. All waste shall be discharge to the trap. The trap and water pipes shall be set in cement concrete blocks firmly supported on the structural floor. The blocks shall be in 1:2:4 and extended 1 ½" below finished floor level. Contractor shall provide all necessary shuttering and centring for the blocks. Size of the block shall be 12" x 12" of the required depth. The floor finish around the floor trap shall be carefully executed by skilled workmen to provide a perfect finish with slopes.

i. Urinal Traps

Urinal traps shall be P or S trap HCI or HDP as per bill of quantities with or without vent and set in cement concrete blocks.

j. Trap Inlets

Where specified contractor shall provide a special type of cast iron / HDP inlet hopper without or with one, two or three inlet sockets to receive the waste pipes. Joints between waste and hopper inlet socket shall be lead caulked joint. Hopper shall be connected to a P or S trap with at least 2" seal (Hopper and traps shall be paid for separately). Floor traps inlet hoppers and traps shall be set in cement concrete blocks.

k. C. P. Grating

Floor and urinal traps shall be provided with heavy C. P. brass grating, with rim of approved design and shape. Minimum thickness shall be 1/8".

B19. MISCELLANEOUS

B19.1 TOOLS & MATERIALS

a. The Contractor at his own cost and charge shall provide all materials, tools, testing materials, scaffolding labour and electric power, necessary for the perfect completion of the whole work.

b. The Contractor shall pay the fees for the materials if directed by the Architects and Local Authorities or other Statutory Authorities.

c. The Contractor shall obtain from time-to-time various permissions and the completion certificates as per rules of all Local and Statutory Authorities.

d. The Contractor shall arrange for the materials and storage facility with the Building Contractor.

e. Any materials, brought at site shall not be removed without the written authority of the Architects and when the Contractor shall have received payment in respect of any certificate in which it is stated that the value of any unfixed materials, on the work has been taken into account, such materials shall become the property of the Employer and the Contractor shall be liable for any loss or damage hereto.

f. The Contractor shall insure the work against damages, for such as the Architect may, from time to time direct. All insurance policies are to be taken out in the joint name of the Employer and the Contractor in an office selected by the Architect and all policies and receipts shall be deposited with the Architects.

g. All the brackets and hangers for pipe shall be fixed to the wall or R. C. C. slab using Anchor fasters, wherever necessary.

h. Surplus materials from the site shall be carried away by the Contractor without any cost to the employer and the storage space provided to the Contractor shall be handed over to the employer clear and ready occupation.

Technical Specification

IT Infra Structure, Cloud & Data Centre Connectivity (DCI) Infrastructure

Technical Specifications - IT Infra structure, Cloud & Data centre connectivity infrastructure (DCI)

Technical Specification (IT Infra structure, Cloud & Data Centre connectivity infrastructure {DCI})

1. Brief Scope of Work

Part (A): IT Infra structure & Data Centre connectivity infrastructure (DCI): The project scope of work contains the comprehensive development of a Disaster Recovery Centre (DRC) within the NEA-owned substation complex at New Butwal Substation, Bhumahi, Nawalparasi Nepal. This initiative involves proper planning and execution across various phases, starting thorough site surveys and design layouts for civil, non-IT & IT infrastructure. The scope of work consists of procurement of necessary technology, equipment, and services for the project and setting up the building for DRC including 60 No's of Racks along with power & cooling solutions, setting up private cloud infrastructure including network and security solutions, and solution engineering and implementation of communication networks, ensuring high-capacity, low-latency with secure data transmission between the Distribution Control Centre (DC) and the DRC sites. Key activities including fibre optic cables maintenance, setting up DWDM equipment & communication to ensure data integrity and availability of DCI solution. The contractor shall conduct all required testing processes such as factory Acceptance Tests (FAT) and Site Acceptance Tests (SAT) to ensure compliance with specifications and successful commissioning. Training programs shall be imparted to NEA personnel, covering specialized and basic skills related to their roles within the DRC and associated facilities, are also integral to the scope. O&M and annual maintenance contract including supply of manpower for DRC, NOC, BMS, Civil Builds, facility management and non-IT & IT infrastructure setup for 3 years from Go-Live. SI shall be responsible for the overall management and supervision of works, including the implementation of risk management, change management and shall provide experienced, skilled, knowledgeable and competent personnel for implementation of all phases of the project with a high-quality system.

Part (B): Private Cloud Services

Orchestration of Private Cloud Services for a NEA Cloud Services. This scope of work details the essential activities, deliverables, and responsibilities involved in orchestrating private cloud services. The goal is to design, deploy, and manage a private cloud infrastructure that aligns with the NEA's operational, performance, and security needs.

Objectives: Create a private cloud platform equipped with automated orchestration features. Facilitate scalable, secure, and resilient cloud services for NEA users. Streamline the management of cloud resources and workflows. Ensure adherence to industry standards and regulations.

Core Activities and Tasks

Planning and Design: Evaluate the current IT infrastructure and outline integration needs. Determine the private cloud architecture (e.g., OpenStack, VMware, or Kubernetes-based). Establish service

catalogues, SLAs, and provisioning workflows. Develop a comprehensive orchestration strategy that encompasses compute, storage, and network layers.

Implementation and Deployment: Configure the cloud management platform (CMP) with proposed orchestration tools. Install essential private cloud components (e.g., hypervisors, storage systems, virtual networks). Implement role-based access control (RBAC) and integrate with Identity and Access Management solution (IAM) for secure user authentication. Activate monitoring, logging, and reporting functionalities. Set up CI/CD pipelines to automate updates and deployments.

Automation and Orchestration: Create and execute automated workflows for resource provisioning, scaling, and decommissioning. Automate processes for load balancing, backup, and disaster recovery. Establish multi-tenancy features with resource quotas and isolation.

Integration with Existing Systems: After the completion of existing contracts of Smart Metering Ph-1 and RMS applications, connect the private cloud with current enterprise systems and applications. Implement APIs for smooth hybrid cloud or multi-cloud environments of existing IT Infra platforms deployed in different projects in NEA.

Security and Compliance: Implement strong security measures such as encryption, firewalls, and intrusion detection systems. Ensure adherence to data protection laws like GDPR and ISO 27001. Carry out security audits and vulnerability assessments regularly. Establish role-based access controls (RBAC) and secure methods for data storage.

Testing and Validation: Conduct functionality tests for resource provisioning, scaling, and orchestration workflows. Perform performance testing under different workloads to confirm scalability. Verify disaster recovery and failover processes.

Training and Knowledge Transfer: Organize training sessions for cloud administrators and end-users. Create documentation covering orchestration workflows, best practices, and troubleshooting techniques.

Ongoing Support and Optimization: Set up a support system for resolving issues and managing system updates. Keep an eye on system performance and usage patterns for optimization. Regularly assess orchestration processes to find opportunities for improvement. –

Deliverables (for private cloud services):

- A comprehensive project plan and architecture design document.
- A fully deployed private cloud infrastructure with complete orchestration capabilities.

- Service catalogue and SLA templates.
- Automated workflows for managing cloud resources.
- A thorough security and compliance framework.
- Documentation and training resources.
- A plan for ongoing support and optimization.

Roles and Responsibilities: Contractor shall study and Identify business needs and expected outcomes. NEA to provide access to current IT systems and resources. Contractor and NEA core Cloud team should work together during testing and validation stages. Contractor to provide Implementation Team and set up the private cloud platform. Create and implement orchestration workflows. Ensure security, compliance, and smooth integration. Contractor should provide support team for continuous support and training for the project duration, support team should share the SLA and Utilization reports each month with NEA team.

1.1 Site Survey

Detailed site survey of all sites to assess requirements such as space, identification of input terminals, availability of air conditioning, spare contacts, communication infrastructure, IT/automation systems, O&M processes pertaining to the network. After the site/route survey the contractor shall submit a survey report for all the sites. This report shall include at least the following items; however, the exact format of the report shall be finalized by the contractor with the approval of employer.

- Proposed layout of equipment in the existing rooms and buildings.
- Proposed routing of power, earthing, signal cables and patch cords etc.
- Confirmation of adequacy of space and AC power supply requirements.
- Proposals for new rooms/buildings, if required.
- Identification of facility modifications, if required.
- Identify all additional items required for interconnection with the existing equipment.
- Requirement of modification to existing earthing arrangement, if any.
- Communication infrastructure.

The bidders are advised to visit sites- DC and DRC (at their own expense), prior to the submission of the proposal, and make surveys and assessments as deemed necessary for proposal submission.

1.1.1 Requirement Gathering & DRC Solution Design

- SI should carry out a detailed requirement gathering exercise with stakeholders and management of NEA for roll out of DRC.
- Overall sizing and designing of DRC should be based on the As-Is status study and requirement gathering exercise.
- The finalized proposed solution 2D and 3D both architectures should be submitted and approved by the NEA before solution customization, development and roll out.

- SI should arrive at the optimum design, architecture, and sizing of communication infrastructure for disaster recovery Centre based on the requirement gathering exercise and should design the solution accordingly.
- SI should also assess the end user expertise level at each office location and suitably modify training/handholding/change management programs for DRC with NEA.

1.1.2 Provisioning of DRC & NOC

SI shall be responsible for supply and installation of necessary hardware, software and supporting systems for successfully running the operations for the scope of work at disaster recovery centre of NEA.

- SI shall update the proposed licenses and version to the latest commercially available version during the currency of the contract.

1.1.3 DR Strategies

The bidder shall formulate/adhere to the existing DR strategy. The following strategies define the structure of the current Disaster Recovery system:

a. **Failover strategy:** This strategy should include the components of the system that will come into play in case of a disaster at the primary site, to ensure that the required services continue to be provided from facilities located at the DR site.

b. **Switchover strategy**: This strategy should include the components of the system that come into play when a planned switchover is made to the DR site for drill or planned maintenance purposes.

c. **Switchback strategy:** This strategy should include the components of the system that come into play when system operation switches back to the primary site after being operated from the DR site. The following cases should be covered:

   i. **Switchback from failover:** In this case, the primary site has to be restarted to the current
   ii. Status of DR site.
   iii. **Switchback from planned switchover**: In this case, the primary site has to be restarted to the current status of DR site.

d. **Testing strategy:** This strategy should ensure that recovery and switchback strategies are regularly tested, periodic drills are conducted, and appropriate corrective and preventive measures are adopted.

e. **Monitoring strategy:** This strategy should state the methodology to effectively monitor DR systems through remote monitoring and from NEA premises by NEA personnel.

f. Switching of applications **from Primary Data Centre to DR Data Centre and vice versa is manual process.**

1.1.4 Failover

a. In the event of a DC disaster, the bidder should ensure that the system failover to the DR site happens successfully & automatically.
b. During the failover, the bidder should ensure that services for all applications should be available to users with minimum service interruption and data loss as per parameters specified in Disaster Recovery Parameter.
c. In general, the system will be considered operational from the DR site when end users are able to connect to application services at DR site.
d. Bidder to generate Reports indicating actual time taken for each activity during failover and deviation from the parameters specified in Disaster Recovery Parameter.

1.1.5 Switchover

a. A Switchover may be required during DR system testing, DR drills or actual disaster.
b. Bidder to make sure that there should be no data loss in case of a switchover.
c. Switchover should be possible for any one application or for all applications simultaneously.
d. Generate reports indicating actual time taken for each activity during failover and deviation from the parameters specified in Disaster Recovery Parameter**.**

1.1.6 Switchback

a) As soon as the facilities at the primary site have been restored, the applications need to be switched back to the primary site from the DR site.

b) Switchback should be a planned activity. There should be no data loss in the event of a switchback.

c) Generate reports indicating actual time taken for each activity during failover and deviation from the parameters specified in Disaster Recovery Parameter**.**

1.1.7 Disaster Recovery Parameter

a. The service parameters to be met by the DR system focus on the Recovery Time Objective (RTO) and the Recovery Point Objective (RPO), which define the interruption to service and loss of data respectively.
b. The RTO will be calculated from the time of “declaration of a disaster” up to the time by which all the applications are made fully operational & end users are able to access these applications & carry out the operations.
c. The following parameters are to be adhered to at the time of a failover:

- RPO – 15 Sec
- RTO – 5 Minutes

d) Following other parameters are also to be maintained:

- Switchover, for the purpose of planned maintenance, testing, process audit, or other similar reason, should be completed within 24 hours of the decision to execute such switchover. No data loss should occur during such switchover.
- Switchback: No data loss is permissible for any application at the time of switchback.
- Switchback in case of complete disaster scenario should be completed within 120 hours after restoration of the equipment up to OS / DBMS /middleware level/ application at the primary site OS/ DBMS / middleware and application level at the primary site.
- Service interruption in the case of both switchover and switchback should not exceed four hours.

1.1.8 DR Drills

a. During the DR drill and failover, the bidder needs to arrange the full DR team with sufficient resources and expertise to complete the activity under the supervision of senior resource for coordination.
b. DR drills should be planned and executed periodically, minimum half-yearly or as per requirement of NEA.
c. Drills to be conducted after approved POA by NEA and confirmation in writing.
d. Signed User Acceptance by NEA is mandatory for declaring completion of successful DR drill.
e. The exact process of the DR drill should be formulated in consultation with NEA (with provision of periodic changes upon mutual consultation) in a way that all elements of the system are rigorously tested, while the risk of any failure during the drill is minimized. The process should be documented by the successful bidder as part of the disaster recovery plan.
f. The date, time, duration, and scope of each drill shall be decided mutually between NEA and the successful bidder. Extreme care must be taken while planning and executing DR drills to ensure that there is no avoidable service interruption, data loss, or system damage.
g. The applications loaded in the DR servers should be tested for consistency periodically, say once a month. A log should be maintained of such tests.
h. Generate reports indicating actual time taken for each activity during DR drills and deviation from the RPO and RTO specified in RFP.
i. After every DR Drill the stepwise activity list along with documentation to be prepared and jointly signed by successful bidder and NEA with appropriate remark.

1.1.9 Data Back-Up and Recovery

a. Planned backups should be maintained at the DR site to recover from a crash / other local failure at the DR site, without affecting the primary system or replication process in any way. The full backup can be taken at the end of the week, whereas incremental backups can be taken every day after discussing with NEA.

b. When the DR site is acting as primary (failover situation), then the backup policies should be similar to those followed in the primary site. The backup policies at the Primary Site will be shared with the successful bidder.
c. Backup media retention policy - at any given point in time at least two full backups and a week of incremental backups must be maintained.
d. Prepare backup procedures that meet recovery and restore needs.
e. Ensure that backup is taken as per NEA's policy and procedure.
f. Recovery and restoration of the servers at DR.
g. As per mutually agreed policies carry out restoration at DR.
h. Perform daily, weekly, monthly etc. backup operations as per the mutually agreed backup strategy and policy with NEA.
i. Ensure proper storage and handling of media to prevent data loss.
j. Generate monthly backup report and submit them to NEA.

1.1.10 Network Management

Responsibilities listed below are applicable to NEA disaster recovery centre network:

a. Ensure that DR networking paths are available with reliable quality and that all networking components are functioning properly.
b. Monitoring and supervision of DR WAN network.
c. Effectively track, manage, communicate and resolve all networking exceptions, issues and problem.
d. Ensure that adequate security is in place to prohibit unauthorized network access from network components under bidder's control.
e. Work with all involved parties (other vendors, NEA personnel, etc.) to resolve all network problems by tracking them till resolution. Ensure network connectivity is available for access 24x7.
f. Schedule outages for network maintenance, expansions and modifications that meet operational needs and minimize disruption.
g. Maintain and provide network documentation. Install, maintain, upgrade and support all network software.
h. Perform tuning to network configuration and network parameters to enhance network performance. Provide capacity modifications if required.
i. Bidders need to co-ordinate with the all-WAN service providers for any connectivity related issues for DR setup and do the required troubleshooting along with service provider.
j. Bidder to carry out all the changes at DR that are being carried out in the DC as per advice of NEA.

1.1.11 Security Management Services

a. Provide and monitor security for the systems and data network. All actionable Security Incidents shall be alerted immediately and required action should be taken.
b. Manage and maintain all Information security software, appliances and component.
c. Execute NEA's approved policies for security devices and follow security policies.
d. Security administration, virus protection and upgrades.
e. Bidder to carry out all the Security Management processes and practices at DR that are being carried out in the DC as per advice of NEA.

1.1.12 Testing

- SI shall carry out the testing, commissioning and acceptance of overall system including hardware and software of DRC, NOC and Equipment room in compliance to the perquisites of Go-live and NEA requirements.
- The supplied hardware and software solution shall meet the necessary standards, compliance and testing criteria.
- The supplied hardware, software and field equipment shall have full warranty support with no restrictions on usage and support during the implementation period of the contract.
- The equipment including all hardware and software should not be end of life/end of support for a period of minimum 3 years from the date of commissioning or the SI shall have to replace the equipment with an equipment (hardware and software) of same specifications.

Factory Acceptance Tests (FAT)

The following materials, but not limited to those listed, must be inspected, examined, and tested by NEA's designated Engineer/Project Manager at any stage of manufacturing and/or construction. NEA's designated Engineer/Project Manager shall have the right to reject defective material.

Sr. No.	Material	Quantum of check
1	Prefabricated Modular	One per Lot
2	Transformer	One per Lot
3	ATS Panel	One per Lot
4	DG set	One per Lot
5	11kV RMU (Ring main Unit)	1 No.
6	Lighting & Power DB (Distribution Boxes)	One per Lot
7	PAC (Indoor & Outdoor Unit)	One per Lot
8	DWDM Equipment	One per Lot
9	IT Rack	One per Lot
10	Cable Trays	One per Lot
11	Lighting	One per Lot
12	PVC cables	One per each Lot

Rejected materials shall be satisfactorily replaced with proper materials without charge thereof and the contractor shall properly segregate and remove the rejected material from the premises. If the contractor fails to proceed at once with the replacement of the rejected material and/or the construction

of defective workmanship, the Engineer-in-charge may replace such material and/or correct such workmanship and charge the cost thereof to the contract.

The contractor shall furnish promptly without additional charge, all facilities, labour and materials necessary for the safe and convenient inspection and tests that may be required by NEA's designated Engineer/Project Manager for the Inspection.

All the factory test inspection, examination and testing shall be carried out in accordance with approved GA drawings, Design, Test Plan. NEA may depute its representative to witness the testing. The contractor shall provide all facility including air tickets, lodging etc. to the deputed representative of NEA for witnessing the factory test.

Before requesting any factory acceptance test, the contractor must submit a written request at least 15 days in advance.

Hardware Integration Test

Applicable hardware diagnostics shall be used to verify that each hardware component is completely operational and assembled into a configuration capable of supporting software integration and factory testing of the system. Equipment expansion capability shall also be verified during the hardware integration test.

Field Tests (Site Acceptance tests -SAT)

The Site Acceptance Test (SAT) and the site acceptance test procedure provides an opportunity for final confirmation that the performance experienced during the Factory Acceptance Testing (FAT) is repeated after the systems are installed onsite, ensuring nothing has changed or was damaged during shipment and installation. This process typically involves full functional testing of the machines/equipment after they are installed and integrated with support systems. Engineers who designed the systems and performed the FAT, also lead the SAT to ensure continuity and completeness.

The SAT provides all parties final confirmation that the systems have met performance requirements:

- Installation is complete and adequate
- Integration with supporting systems is appropriate
- Important process parameters are achieved
- Functionality is aligned with requirements
- Usability is intuitive and high quality

All the necessary arrangements to conduct SAT are to be made by the contractor and in case the manufactured and delivered equipment fails to meet the standard, it shall be the duty of contractor to re-manufacture and deliver new equipment following all the procedures again.

The field test Site Acceptance Tests (SAT) shall fully validate all hardware and software features. The bidder must submit a detailed SAT procedure, which should be reviewed in conjunction with the specifications.

Field Installation Tests:

The equipment which has undergone the factory testing shall be installed at site.

The field installation test shall include the following:

a) Proper installation of all delivered hardware as per approved layout.
b) Interconnection of all hardware
c) Interconnection with communication equipment's
d) Interconnection with power supply
e) Diagnostic tests to verify the operation of all hardware

The Contractor shall be responsible for performing the field installation tests and employer may witness these tests.

End-to-End Test

DRC Testing

Final Acceptance Testing

- The final acceptance shall cover 100% of the Disaster Recovery Centre.
- After successful testing by the NEA or its third-party monitoring agency; a final acceptance test certificate (FAT) shall be issued by the NEA to the SI.
- The date on which final FAT certificate is issued shall be deemed to be the date of successful commissioning.
- Detailed test plan shall be proposed by SI and approved by NEA.
- This shall be submitted by SI before FAT activity to be carried out.
- All documentation relevant acceptance test document should be completed & submitted before the final acceptance test to the client (NEA). The training requirements as mentioned should be completed before the final acceptance test.
- Final acceptance shall include the following:
- OEM certification of all the components installed.
- All hardware and software items must be installed at site as per the specification.
- Availability of all the defined services shall be verified.

1.1.13 Training for DC/DRC, Cloud, Optical fibre and Communication equipment

This section describes general requirements that apply to all training courses. The Contractor shall submit the training proposal along with the bid. The training content, schedule and location shall be as follows.

a) Training at Manufacturer/Supplier's premises authorized training center.

General

(a) Training will be conducted by Contractor's personnel, who are experienced instructors and speak understandable English.

(b) All necessary training materials shall be provided by the Contractor. Each trainee shall receive individual copies of all technical manuals and all other documents used for training.

(c) Class materials, including the documents sent before the training courses as well as class handouts, shall become the property of owner. Employer/owner reserves the right to copy such materials, but for in-house training and use only.

(d) Hands-on training shall utilize equipment like that being supplied under the contract.

(e) SI shall conduct abroad training to the owner's employees as described in BOQ. All the expenses including training cost, airfare, hotel accommodation, food and incidental allowances (USD 150 per person per day) etc. shall be provided by the SI and has to include in proposed financial bid proposal.

(f) The Contractor shall quote training prices under project management cost & shall be included in the bid.

(g) The schedule, location, and detailed contents of each course will be finalized during employer and Contractor discussions shortly after placement of the award. The Consultant/Employer shall review and approve the contents of the overview training prior to the start of the training.

b) Training in Nepal to be conducted locally.

General

(h) Training will be conducted by Contractor's personnel, who are experienced instructors and speak understandable English.

(i) All necessary training materials shall be provided by the Contractor. Each trainee shall receive individual copies of all technical manuals and all other documents used for training.

(j) Class materials, including the documents sent before the training courses as well as class handouts, shall become the property of owner. Employer/owner reserves the right to copy such materials, but for in-house training and use only.

(k) Hands-on training shall utilize equipment like that being supplied under the contract.

(l) The Contractor shall quote training prices under project management cost. & shall be included in the bid.

(m) SI shall conduct local training in Nepal and all the training cost including trainer's charge, accommodation, lunch for the trainees, training venue etc. has to be provided by SI and has to include in proposed financial bid proposal.

(n) The schedule, location, and detailed contents of each course will be finalized during employer and Contractor discussions shortly after placement of the award. The Consultant/Employer shall review and approve the contents of the overview training prior to the start of the training.

Training course requirements

Employer's training course requirements are described below in terms of the contents of each course to be provided. Training shall be provided on actual database for the application software course and the associate training courses.

Computer system hardware & software course

The computer system hardware & Software course shall be offered, at the system level only. The training course shall be designed to give owner hardware & software personnel sufficient knowledge of the overall design and operation of the system so that they can correct obvious problems, configure the hardware, perform preventive maintenance and run diagnostic programs. The following subjects shall be covered:

(a) System hardware overview: Configuration of the system hardware.

(b) Operating system: Including the user aspects of the operating system, such as program loading and integrating procedures; scheduling, management service, and utility functions; and system expansion techniques and procedures

(c) System initialization and fail over: Including design, theory of operation, and practice

(d) Equipment maintenance: Basic theory of operation, maintenance techniques and diagnostic procedures for each element of the computer system, e.g., processors, auxiliary memories, LANs, routers and printers. Configuration of all the hardware equipment's.

(e) Diagnostics: Including the execution of diagnostic procedures and the interpretation of diagnostic outputs,

(f) System expansion: Techniques and procedures to expand and add equipment such as loggers, monitors, and communication channels.

(g) System maintenance: Theory of operation and maintenance of the hardware configuration, fail over of redundant hardware etc.

(h) Operational training: Practical training on preventive and corrective maintenance of all equipment, including use of testing tools.

Application Software Course

The Contractor shall provide training on application software courses covering all applications other than those already covered above. The training shall include:

(a) Overview: Block diagrams of the application software and data flows. Programming standards and program interface conventions.

(b) Application Functions: Overview of functional capabilities, design, and algorithms. Associated maintenance and expansion techniques.

(c) System programming: An introduction to software architecture, Effect of tuning parameters (OS software, network software, database software and application Software etc.) on the performance of the system)

(d) Software documentation: Orientation in the organization and use of system software and application software documentation.

(e) Hands-on training: shall be provided with allocated computer time for trainee performance of unstructured exercises and with the course instructor available for assistance as necessary.

Communication system training:

The training shall focus on critical aspects associated with installation, testing & commissioning of fibre optic system, network and communication device systems, radio etc. Leased network equipment is however, responsibility of service provider & contractor who has signed SLA with utility, but required level of knowledge for troubleshooting, up keeping the equipment will be required. This shall include the state-of-the art techniques employed in laying, splicing & testing of fibre optic cable & terminal equipment's etc. The owner's personnel shall be trained in such a way that the basic maintenance of terminal equipment's & cable etc. can be carried out effectively.

Auxiliary power supply training

The training shall cover various aspects covering installation, testing & commissioning of DC power supply, & UPS system. Proper emphasis of the training shall be for effective operation & maintenance of auxiliary power supply system on routine/emergency basis by the owner's personnel.

Training for civil and non- IT components

The selected bidder shall conduct training after installation and commissioning have been completed. Training will be provided by the selected bidder from the respective OEMs or OEM authorize partners or certified resources to the officials of NEA IT department and other departments, for a maximum of 10-12 people to be identified by the NEA, in a phased manner at the premises provided by the NEA. Non- IT training would include training on operation of precision AC, UPS Systems, bus bar electrical systems, BMS systems like access control, fire detection and suppression system, security aspects of the disaster recovery Centre, education on how the passive network cabling has been done on the overall expansion area build etc.

1.1.14 Operation and maintenance services (O&M)

(a) SI shall carry out the operation and maintenance services support for a period of three (3) years after the date of Go Live of DRC.

(b) The details of activities covered under the facility management and expected service levels are mentioned in Operation and maintenance services.

1.1.15 Risk mitigation

SI is expected to work with NEA to regularly review, create and amend the list of risks and their mitigation strategies. The possible risks could be, but are not limited to the following:

- Achieving required performance and SLA requirements.
- Integration related issues.
- Communication network performance.
- Inadequate participation by utility staff.
- Information security issues.
- Information required for the project cannot be provided in the planned timeframes.
- Not meeting utility's expectations in terms of scope, timing, and quality.
- Project scope creep.
- Lack of project ownership.
- Availability of internal and external resources.
- Not signing off project deliverables and providing project acceptance in a timely fashion.
- Logistic delays.
- Delay in project timelines.
- Rectifications of faults and issues within the SLA's.

1.1.16 Exit Management and Knowledge Transfer

- SI shall prepare an exit management plan for transfer of knowledge and operations details to the NEA or its nominated agency or its replacement system integrator (SI), in the event of termination or expiry of contract with NEA, without affecting services to stakeholders adversely. The bidder shall get this exit management process approved by NEA.
- SI shall carry out the transition of work and services to suitable agency or NEA under the supervision and approval of NEA, post successful completion of scope of work and inline to the formulated process and procedures of exit management plan.
- The exit management process will include but not be limited to, conducting a detailed walkthrough and demonstrations of the DRC facility, handover of all relevant documentation, address the queries/clarifications with respect to the working/performance levels of the IT Infrastructure, software licenses, handover of customized source codes, policies, and procedure document, conducting training sessions etc.

- SI shall provide the detailed description for service delivery management for the complete project in their project to-be document including transition plan and deliverables.
- During the exit management period, the bidder shall use its best efforts to deliver the services.
- Payments during the exit management period shall be made in accordance with the terms of payment schedule and contractual conditions or as mutually agreed between bidder and NEA.
- Exit management plan shall be furnished by bidder to NEA or its nominated agencies within 3 months from the date of signing the contract.

1.1.17 Change Management

- Bidders will be evaluated/monitored on their dedication to methodology and ability to stay focused on the business process change and expected outcomes/benefits.
- NEA will finalize the scope of change management procedure during development/ implementation stage in consultation with the bidder.
- SI shall be responsible for submitting a rate card that would be required to carry out software customization.
- All hardware associated costs post project completion shall be covered under the O&M section of the document.

1.1.18 Facilities to be provided by NEA

- NEA shall provide required land for DRC.
- NEA shall provide dark core OPGW cable between DC and DRC site through redundant path (Path I: -Kathmandu-Hetauda-Bharatpur-Butwal and Path II: - Kathmandu-Marsyandi PH-Pokhara-Kaligandaki-Butwal, Path-III: - 220 kV Line from Kathmandu-Marsyangdi S/S-Bharatpur S/S to New Butwal S/S).
  Note: Bidder shall consider two Path only during design phase.
- NEA shall ensure the accuracy of all information and/or data described in the scope of work and bid document, except or when otherwise stated in the contract.
- Shall review and approve the contractor's design, drawing, survey reports and recommendations.
- Shall review and approve test procedures.
- Shall participate in and approve the factory and site acceptance tests.
- Shall review and approve the training plans.
- Shall review and approve the FMS SLA report with logic to calculate the SLA.
- Shall provide support and access to facilities at the installation and commission sites.
- Will arrange necessary shutdowns and work permits.

- Provide access to data centre and disaster recovery sites for solution assessment, installation, implementation, and overall operations.
- Shall obtain requisite clearances and/or approvals as required to be taken for project.
- Shall organize project review meetings.
- Shall provide the necessary space for day-to-day operation at NEA premise.

1.2 Documentation and Deliverables

General overview

To ensure that the proposed systems conform to the specific provisions and general intent of the specifications, the bidder shall submit the required documentation and deliverables to the NEA describing the overall-system components/design/operations/maintenance process etc. for review and approval. Further the bidder shall also submit the drawings/documents for all the hardware and software required for site installation, testing, and commissioning and thereafter operations of the system. Bidder shall obtain necessary approval of employer (NEA) for the relevant document at each stage before proceeding for purchase, manufacturing, system deployment, factory testing, erection, site testing, training etc.

Instructions

The submitted documents shall have the unique identification no. and every revision shall be mentioned. Bidder shall submit the hard copies of each document/drawing for employer's (NEA) review and approval along with the soft copy of documents with each submission. After necessary approval on the final sets of all documents obtained from the NEA, the bidder shall submit the final documentation. Any changes observed during the field implementation shall be incorporated in the as-built drawing and copies of same shall be submitted to the NEA authority.

Bidder shall also supply the technical user manuals/guides/maintenance manuals/manufacturer's catalogues for all the hardware and software supplied under the contract. The user manual shall at minimum include the principle of operation, block diagrams, troubleshooting, diagnostic and maintenance procedures.

Deliverables and documentation requirements

The complete documentation of the systems shall be provided by the contractor. Each revision of a document shall highlight all changes made since the previous revision. Employer's intent is to ensure that the contractor supplied documentation thoroughly and accurately describes the system hardware and software.

The contractor shall submit the paper copy of all necessary standard and customized documents for DRC in 2 sets for review/approval by the employer for necessary reference which includes the following:

A. Documents and deliverables – overall project

A. Project team structure with necessary approval.
B. Project inception report.
C. Project As-Is report.
D. Site survey report.
E. System overview document.
F. Cross reference document.
G. Functional design document.
H. Standard design documents.
I. Design document for customization.
J. System administration documents- software utilities, diagnostic programs etc.
K. Software description documents.
L. Bill of quantity &list of hardware deliverable.
M. Point address document.
N. Training documents.
O. Test procedures.
P. Test reports.
Q. Hardware description documents.
R. Hardware user documents.
S. Hardware maintenance documents.
T. Data Requirement Sheet (DRS) of all hardware.
U. Site specific layout, installation, BOQ, schematics and cabling details drawings/documents.
V. Cyber security plan &mitigation document for the system if public networks are used.
W. Go-Live criteria compliance.
X. FMS reports.
Y. Change management.
Z. Exit management report.
AA. User manuals.
BB. System administrator manuals.
CC. OEM functional manuals.
DD. Product manuals.
EE. Technical manuals.
FF. Installation guides.
GG. Business process guides.
HH. Program flow descriptions.
II. Sample reports.
JJ. Screen formats.
KK. Toolkit guides.

LL. Troubleshooting guides.
MM. FAQ guides.
NN. Any other document/report/certification as required by NEA.

B. Documents and deliverables – DRC, NOC, Civil and non-IT infrastructure

A. Both 2D and 3Dlayoutsof the disaster recovery Centre.
B. Access control system layout.
C. Cold aisle containment.
D. Electrical layout.
E. Lighting and Earthing layout.
F. Loose furniture details.
G. Fixed furniture details.
H. Civil addition and alteration details.
I. Internal/ sectional elevation.
J. Cabling layout.
K. CCTV layout.
L. Rodent repellent layout.
M. Fire detection system layout.
N. Water leak detection system layout.
O. DG foundation layout.
P. DG stack drawing.
Q. PAC piping layout.
R. Cable trench layout.
S. NOC room 3D layout.
T. Coordinated drawing of all systems inside and outside.
U. Any other document/report/certification as required by NEA.

After approval two sets of all the above documents as final documents shall be delivered to site by the Contractor. In case some modifications/corrections are carried out at site, the contractor shall again submit as built site-specific drawings in three sets after incorporating all such corrections as noticed during commissioning. Any software modifications/updates made at site shall also be documented and submitted in three sets to site and one set to employer.

In addition to paper copies, two sets of final documentation shall be supplied on electronic media to employer. Paper copies of these may be submitted, if the same are available from the OEM as a standard part of delivery.

1.3 System Go-Live and Acceptance Criteria

General requirements and conditions

The purpose of this section is to collate the information regarding the state of the project prior to declaration and acceptance of the Go - Live. Whilst there are certain mandatory criteria for declaring

the Go-Live however they might be exempted & relaxed, in case of any exception and appropriate approval from the NEA authority. These include the following as per bid document requirements:

- Submission of project documentation and deliverables and requisite sign offs obtained.
- DRC, NOC and civil build and non-IT infrastructure test, supply, installation and commissioning completed as per scope.
- Network connectivity provisioned and communicating at all locations as per scope.
- FRS compliance achieved.
- Fit/Gap analysis completed.
- Compliance to SLA for at least 3 months before Go-Live declaration.
- Training provided as per schedule and scope approved by NEA.
- Exit management and handover plan accepted by the NEA.
- Detailed schedule available for Go – Live.
- Adequate manpower for O&M in place for handover.
- Scope of work completed and signed off by NEA.

1.4 Implementation Plan and Schedule

The DRC is planned to be implemented in three different phases as described in the figure according to the timetable shown in table below: -

Sl. No	Activity Name	Timelines
1	**Contract Finalization and Award of Work**	T+1
2	**Project Initiation Stage**	
a	Project Kick Off	
b	Presentation on Execution Approach & Methodology to Senior Management	
c	Onsite Office Setup & Team Mobilization	
3	**DRC Building Civil Construction Phase: A**	T+9
a	Site Survey	
b	Design Finalization	
c	Permitting and Approvals	
d	Ordering Materials and Modules	
e	Material Quality Inspection	
f	Site Clearing and Excavation	
g	Site Grading and Utilities	
h	Foundation Excavation	
i	Foundation Construction	
j	Supply and Delivery Planning	
k	Pre-Dispatch Inspection	
l	Delivery of Modular Units	
m	Assembly of Modular Units	
n	Roof Installation	

o	Exterior Finishing (Walls, Windows)	
p	Interior Wall Construction	
q	Electrical and Plumbing Installation	
r	HVAC Installation	
s	Interior Finishing (Painting, Flooring)	
t	Fixtures and Fittings Installation	
u	System Testing and Commissioning	
v	Inspection and Punch List	
w	Final Clean-up and Handover	
4	**DRC Civil Build and Non-IT Infrastructure Phase: B**	
a	Site Survey report	
b	Technical Design Documents approvals – HLD & LLD with layouts, schematics including communication network architecture	
c	Factory Acceptance Testing	
d	Procurement equipment/material for civil build and Non-IT Infrastructure	T+15
e	Pre dispatch inspection	
f	Supply equipment/material for civil build and Non-IT Infrastructure	
g	Install equipment/material for civil build and Non-IT Infrastructure	
h	Site Acceptance Testing	
i	Commission DRC and Non-IT Infrastructure and ready for occupancy	
j	Acceptance and Handover	
5	**DWDM Infrastructure Phase: C**	
a	Site Survey report	
b	Technical Design Documents approvals – DWDM Infrastructure	
c	Factory Acceptance Testing	
d	Procurement equipment/material for DWDM Infrastructure	
e	Pre dispatch inspection	T+15
f	Supply equipment/material for DWDM Infrastructure	
g	Install equipment/material for DWDM Infrastructure	
h	Site Acceptance Testing	
7	Commission DWDM Infrastructure	
a	Acceptance and Handover	
6	**DC - DRC Private Cloud Phase: D**	T+18
a	Technical Design Documents approvals -DC	
b	Factory Acceptance Testing -DC	
c	Procurement equipment/material for DC Cloud H/w and S/w	
d	Pre dispatch inspection -DC	
e	Supply equipment/material for DC Cloud H/w and S/w	T+6
f	Install equipment/material for DC Cloud H/w and S/w	
g	Site Acceptance Testing -DC	
h	Commission DC Cloud H/w and S/w	
i	Acceptance and Handover -DC	
a	Technical Design Documents approvals	
b	Factory Acceptance Testing	
c	Procurement equipment/material for DRC Cloud H/w and S/w	T+18
d	Pre dispatch inspection	

e	Supply equipment/material for DRC Cloud H/w and S/w	
f	Install equipment/material for DRC Cloud H/w and S/w	
g	Site Acceptance Testing	
h	Commission DRC Cloud H/w and S/w	
i	Acceptance and Handover	
7	**O&M Phase:**	
a	O&M Services support for 3 (three) years post Go-Live including facility management and manpower services for: Phase A, B, C, D	T+78
8	**Training and Capacity Building**	
a	Continuous Training & handholding of Stakeholders.	T+78

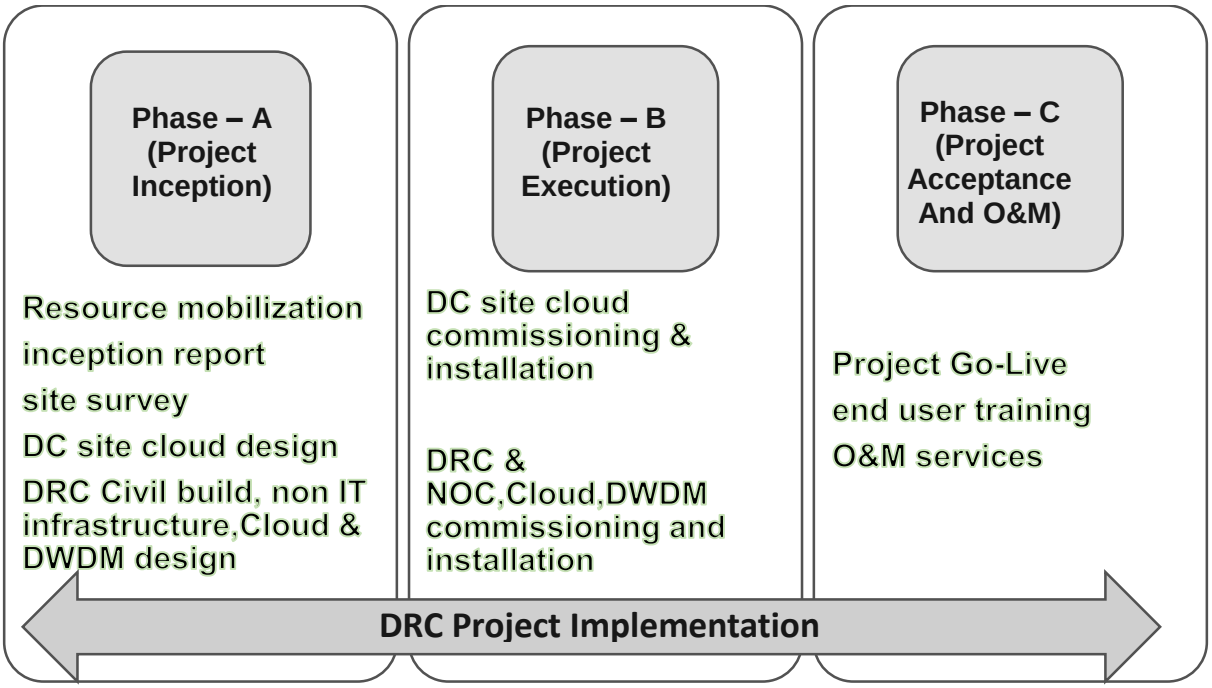


Figure1: Indicative phases of the project

Project Phase A:

This phase will include the tender notice circulation for the project, contract finalization, resource mobilization and establishment of site offices at the client side along with the project inception report and comprehensive bill of material.

During this phase, the bidder shall accomplish the site survey, identification of network connectivity feasibility, DRC, NOC and civil and non- IT infrastructure build and design.

This phase will also include the quality assurance of the supplied material and equipment through Quality Assurance (QA) testing and Factory Acceptance Test (FAT) in compliance to the bid document requirements.

Project Phase B:

This phase shall include in complete conformity with subsequent sections of the specifications, engineering, manufacturing, supply, transportation & insurance, delivery at site, unloading, handling,

storage, installation, integration, configuration, testing, commissioning, demonstration for acceptance of the following: -

a) Building civil work and building construction.
b) DRC facility and non-IT infrastructure for DRC&NOC.

This phase shall also include installation and commissioning of civil build and non- IT infrastructure, construction of DRC, NOC and development of network connectivity between DC and DRC.

Project Phase C:

This phase shall include Go-Live in compliance to the bid document, Go-Live requirements, and standards agreed for overall system acceptance by the owners. During this phase the SI will carry out the capacity building exercise for NEA and will impart training to the utility personnel.

As such, SI is expected to provide services as per best industry standards with performance levels meeting or exceeding those mentioned in Service Level Agreement (SLA) agreed between utility and bidder.

Once the DRC, NOC is operational and all the Go-live criteria is achieved within the project time duration, the O&M shall begin. SI will perform the O&M activities for the project sites for the period of 3 years in compliance to the SLA defined in the RFP.

1.5 PROJECT GOVERNANCE STRUCTURE

SI shall assemble an experienced team with significant P&U knowledge, IT strategy capabilities, and practical experience serving the utility industry in the areas of DC-DRC, NOC, Civil Build and non- IT infrastructure IT implementation, utility business process and overall project management. The overall project implementation will be monitored by the project governance team which includes stakeholders both from NEA and system integrator.

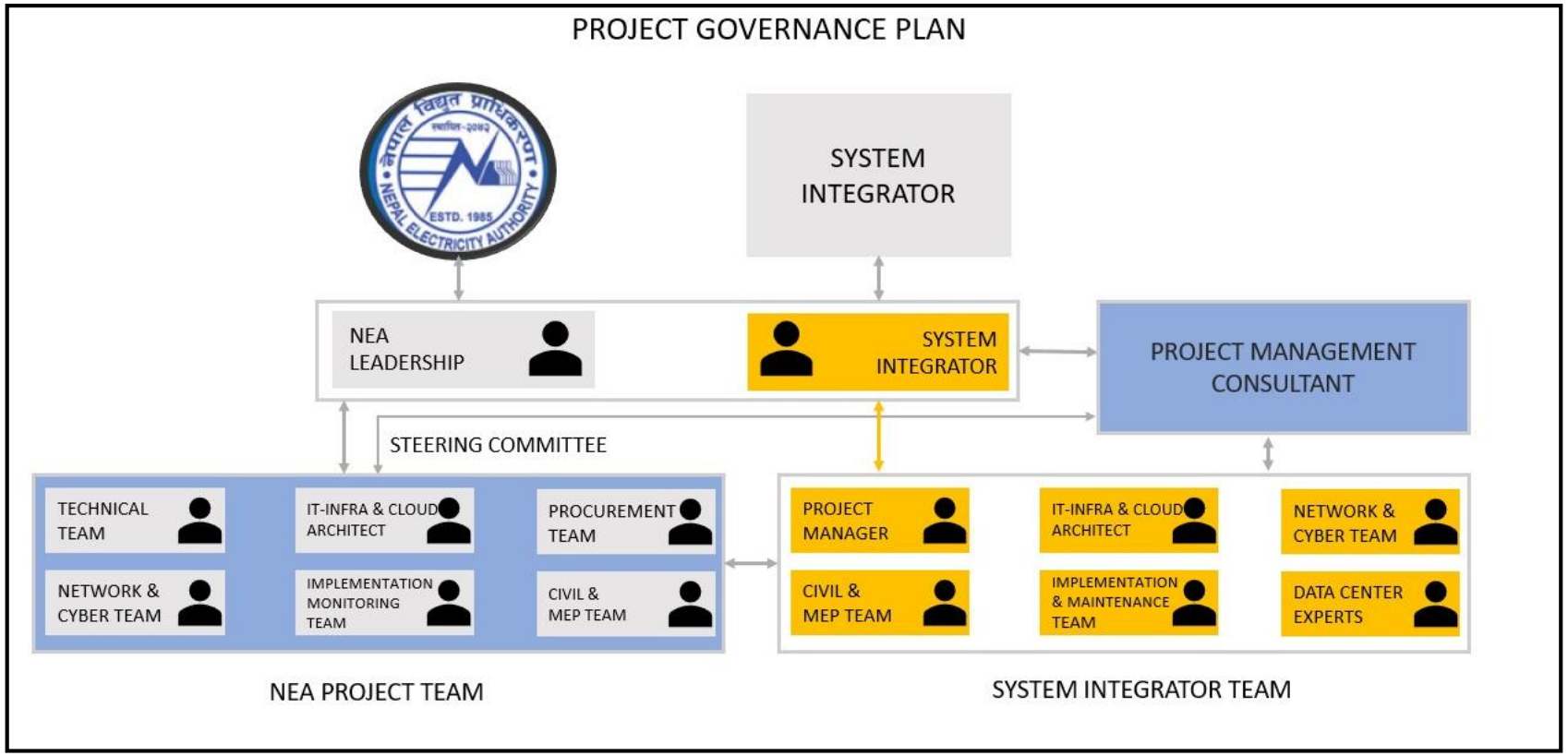


Figure 2: Indicative Project Governance team

1.6 Minimum Indicative Manpower Requirement

General Requirements and Conditions

a) Bidder shall provide the CVs of the proposed personnel in the relevant format with the technical bidding documents.
b) Bidder shall submit a detailed resource deployment plan including manpower proposed for field activities.
c) The indicative number of resources are minimum and would be required during all phases of the project to meet the required service levels.
d) Deployed key personnel can be replaced from the assignment only with a person of similar/higher experience and qualification subject to approval of NEA.
e) Deployed key personal and all other staffs should be fluent in English or Nepalese language.
f) In case, if any offshore resources are involved in the project, the bidder shall highlight the requirement and deployment for the needful.
g) NEA has all rights to reject any under qualified, low experienced resource at any time.
h) All the foreign/International resources should have suitable residence or business visa as per Nepal rules. Visit visa for the engaged resources shall not be accepted.

The bidder must propose a team consisting of experienced and skilled professionals with relevant experience in the proposed areas. The minimum desired qualification for the key personnel has been indicated below. The bidder must demonstrate that it will deploy at least the following personnel for the key positions that meet the following requirements:

Sl. No.	Role	Responsibility	Desired Qualifications
1	Project Manager	Project co-ordination. The Project Manager would be responsible for all the NEA locations and would act as a one-point contact for NEA.	MBA/PGDCA/PGDBA with MTech/B.Tech / B.E. with relevant project management certifications and minimum 10 years of experience with 4 years or more as a project manager for a large-scale IT project in power sector and power distribution automation projects. Project Manager should be fluent in English.
2	IT Infra & Cloud Expert	Shall be responsible for end-to-end IT- Infra and Cloud Architecture and implementation ensuring data integrity, security and high availability.	MCA / B. Tech / BE / CCNP / CCNA / Industry equivalent certification with minimum of 3 years of experience as a network administrator
3	Network & Security Expert	Shall be responsible for end-to-end network management including monitoring and troubleshooting of	MCA / B. Tech / BE / CCNP / CCNA / Industry equivalent certification with

Sl. No.	Role	Responsibility	Desired Qualifications
		network requirements ensuring ensures resilient, secure connectivity and robust protection	minimum of 3 years of experience as a network administrator
4	Site engineers for non-IT infrastructure	Will be responsible for and would assist in the installation, commissioning, and maintenance of the disaster recovery centre.	B. Tech / BE having relevant minimum of 3 years of work experience in power distribution automation / MEP projects.
5	Site technician	Will be responsible for execution installation, commissioning and maintenance of DRC as per job assigned by Site engineer.	ITI or Diploma in electrical having relevant minimum 3 years of work experience in electrical projects.
Note: For O&M of DRC following key personal shall be deployed at DRC.			
5	Facilities Management Coordinator	Responsible for coordinating over all operation of DRC and facility management at location.	B. Tech / BE / Diploma (IT or CS) with minimum of 2 years of experience as a facilities management coordinator.
6	Electrical Engineer	Responsible for all electrical and mechanical systems including mains supply, generator and diesel sets, UPS system operations, power distribution systems, cooling systems (PAC) and all aspects of critical and essential power to the entire DRC, NOC.	MCA / B. Tech / BE / Diploma (IT or CS or Electronics/Electrical) with minimum 3 years of experience.
7	Electrical Technician	Responsible for carrying out new installations and fault diagnosis work on new NOC, and DRC electrical wiring, designing as per sitting plan and other infrastructure. It will involve carrying out power works, assisting in disaster recovery centre installations and all general installation work.	Diploma (Electrical) with minimum 3 years of experience.

Sl. No.	Role	Responsibility	Desired Qualifications
		Candidates must be experienced in working with 3 phase power supply and have an understanding/exposure to the conversion from AC to DC power.	
8	System Administrator	System administrator shall be responsible for all the requisite system administration and facility management work required for central servers, user configurations, account management, network management and management of software, security, and network solutions on 24X7 basis.	MCA / B. Tech / BE with MCSE / Unix certified professional with minimum of 2 years of experience as a system administrator.
9	Certified data centre professional	Responsible for equipment maintenance tasks such as managing and installing upgrades, replacing cables, components and accessories, also maintaining records and drawing schematics of the DRC to detail what equipment's are installed.	MCA / BE / B. Tech minimum experience of handling at least one similar kind of data centre project with 3 years of experience. Certified Data Centre Professional or equivalent from independent body.
10	IT Support Staff	Facilities management support for software, hardware, network and other infrastructure provided to users. Also assist in end user training and handholding for carrying out day to day operations.	MCA / B. Tech / BE / Diploma (IT or CS) with minimum 2 years of experience in support role for an IT project.
11	Computer/ Electronics Engineer	Responsible for setting up of DRC, NOC and implementation of management tools and providing support for start-up, commissioning, and integration of new IT equipment's in racks and provide support in connecting with Ethernet	MCA / B. Tech / BE / Diploma (IT or CS or Electronics/Electrical) with minimum 3 years of experience.

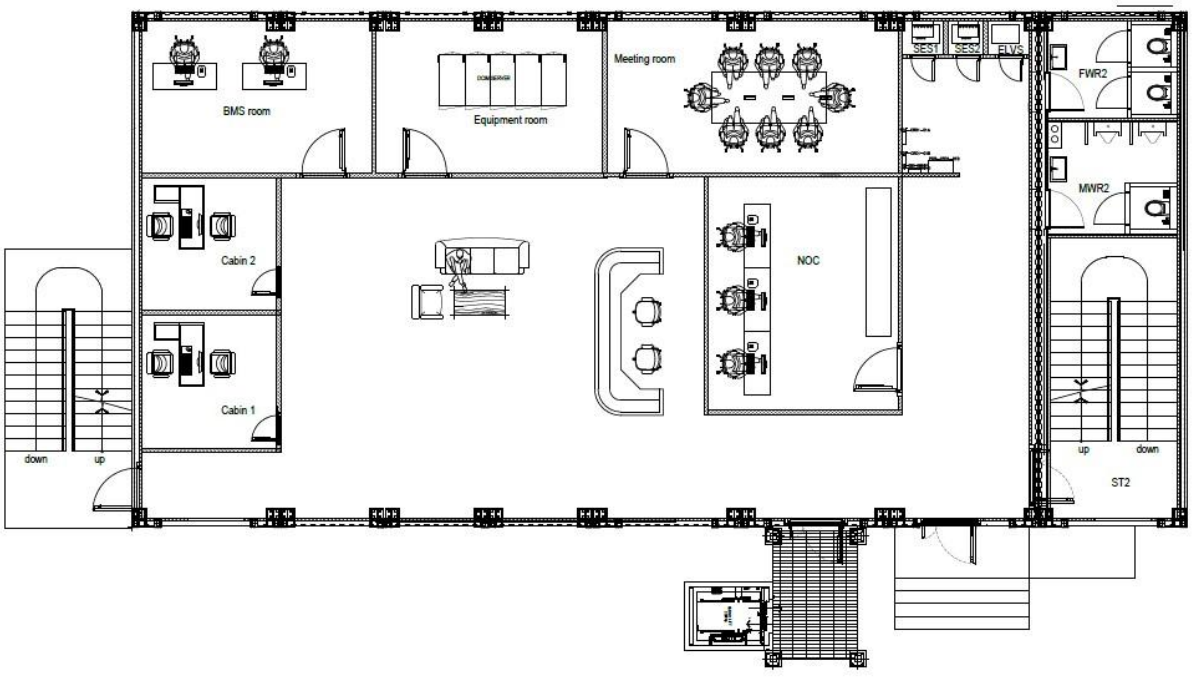
Sl. No.	Role	Responsibility	Desired Qualifications
		and fibre cabling including jack panels, patch panels and other facilities infrastructure. Provide operational and maintenance insights into design review process for each component of the entire DRC, NOC.	

2. Building civil work and accessories requirements

2.1 Building civil work and Conveyance System

2.1.1 DRC General Requirements

The building should be built by pre-fabricated module, which should be module design and pre-fabricated in factory. The module dimension should be 12192 mm (40 ft) * 2438mm & 3495mm width * 4150 mm height. The building is with 2 floors, the basic layout plan is as below:

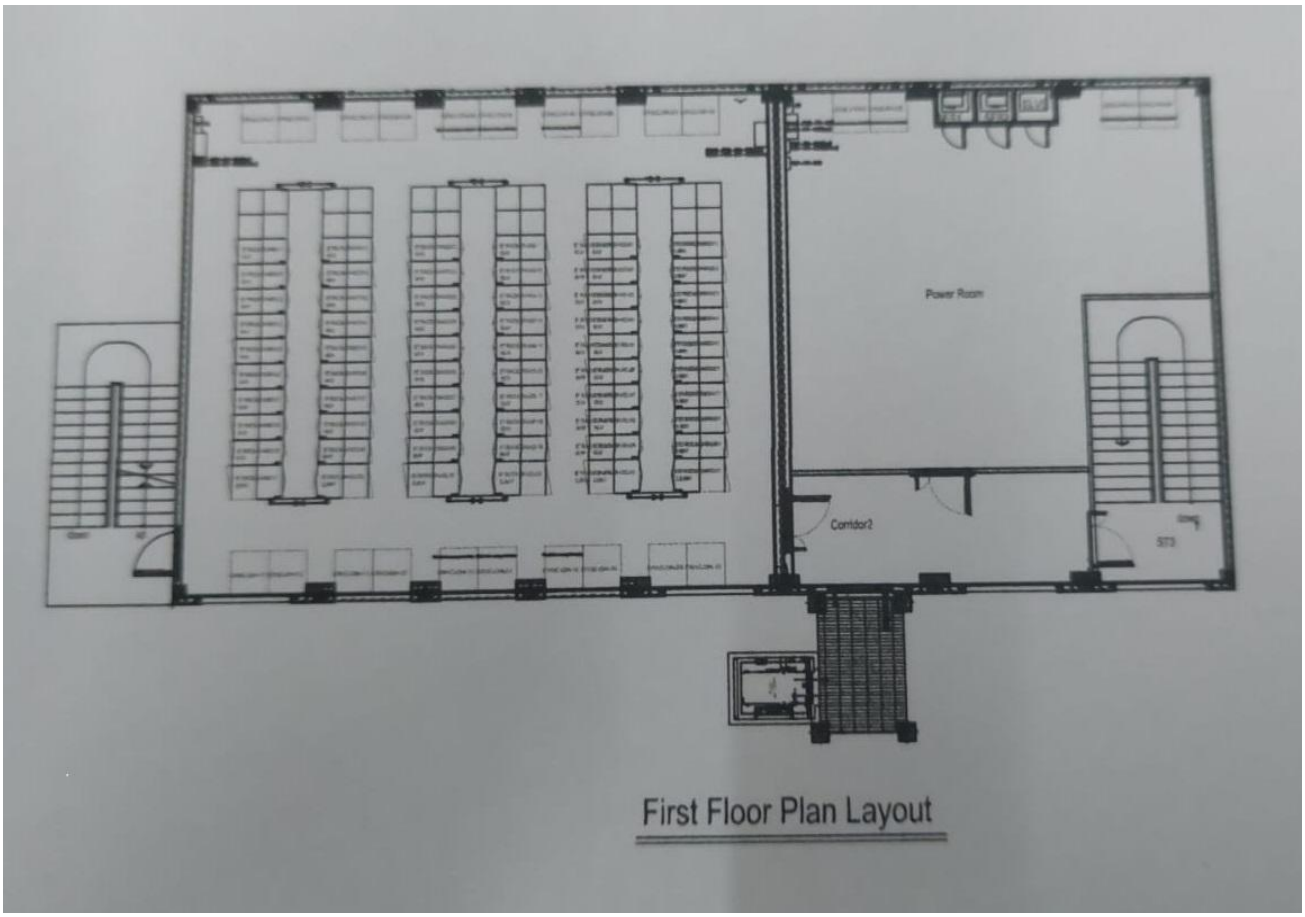


Ground Floor Plan Layout

Figure3: Ground floor layout plan (illustrative only)

NOC room: 265 sq ft; Equipment room: 200 sq ft; BMS room: 210 sq ft; meeting room: 260 sq ft; 2 cabin rooms: 220 sq ft ; Reception Area: 650 sq ft; M-Rest Room: 3 people; F-rest room: 3 people (165 sq ft).

Figure4 (below): First floor layout plan (Illustrative only)



Data hall: 1765 sq. ft; power room: 850 sq. ft, Corridor Area 190 sq. ft.

All equipment room should provide a standard environment for the reliable running of the equipment, such as computer, network system, servers, and storage. The temperature, humidity, cleanness, electrical performance, electromagnetic field strength, fire resistance, load bearing capacity, anti-static capacity, anti-interference capacity, leak proofness, lightning protection, and grounding should meet the requirements of the equipment and local code. The design and construction must comply with related international standards, specifications, and regulations. In addition, the construction requirements of the construction site must be strictly followed. A modern and standardized computer pre-fab building must be constructed according to international specifications.

The design and construction of the equipment pre-fab building must comply with the principles of advanced technology, economical and applicable, security and reliability, and scalability.

2.1.2 Building Architecture Requirement

- The building shall be housed in structures constructed from standard prefabricated container modules, pre-fitted with all the relevant fit-outs.
- The dimensions of the prefabricated modules should comply the certification of IACS (Classification society). For enough indoor space of equipment, the recommendation height of each floor should not less than 4.15 m.
- The recommendation dimension of pre-fab module is 4150mm×2438mm×12192mm (H*W*D), 4150mm×3495mm×12192mm (H*W*D).
- The building should support minimum 2-layer stack deployment. The civil foundation shall be designed to accordingly for 2-layer stacking and can meeting Nepal building seismic requirements the disaster recovery centre structures shall meet the local building standards and codes the building structure report b or similar structural calculation report by SAP2000 is required to prove its performance.
- The buildings and facilities should be protected from dust and water ingress to IP55 rating with 3rd party test report.
- The prefabricated modules are to be suitable insulated and design to be deployed in the harshest of environments of 20 years as found in as per ASHRAE guidelines.
- Anti-seismic test and fire resistance test should be implemented. The prefabricated module should meet the local standard of anti-seismic performance. Also, should meet the requirement of 90min fire proof requirement. The vendor should provide 90min fire-proof third party test report.
- For better cooling energy efficiency, the thermal insulation layer of the prefabricated modules should be ≥100 mm thickness while the thermal efficiency should ≤0.3W/ (m2*K).
- In order to provide better performance of building, all pre - fab modules need to pass not less than 30 days of salt spray test and provide international standard third party reports.
- Steps, stairs and ramps are to be provided to access all the prefabricated modules.
- Detail site survey must have done by the bidder before submitting the bid. NEA will consider it is done, whosoever has submitted a bid.
- The bidder must obtain the following system certification and be able to provide the appropriate certificates:
  - ISO 9001/TL 9000 International quality system certification
  - ISO 14001 International environmental management system certification
  - OHSAS 18001 Occupational health and safety management system certification
- The Energy Facility of DRC room should be pre-assembled and pre-tested in factory no less than 80% and can support FAT in factory.

2.1.3 Prefab Module Requirements

2.1.3.1 The building codes and specifications

The structural design is in accordance with the following codes and specification:

1. General construction in steel code as per International Standard.
2. Criteria for earthquake resistant design of structures, part1 general provisions and buildings, as per International Standard.
3. Code of practice for design loads (Other than earthquake for buildings and structures) as per International Standard.
4. 2.1.3.2 Building Loading Capacity

The building loading should be design for minimum requirement as follow (as indicated in the BPS):

- Roof loading: 0.75 kN/ m^2
  - Loading on top of the module: 0.6 kN/ m^2
- Data hall loading: 8.4 kN/ m^2
- Power supply and distribution pumps and other supporting areas of load: 12 kN/ m^2
- DRC, NOC, office, meeting room and other area loads: 5 kN/ m^2

2.1.3.3 The Prefab Module specifications

1. Enclosure components

The enclosure skeleton is the main support structure that allows the enclosure to be hoisted and loaded. All the side panels, thermal insulation layer, and openings of the enclosure are dependent on the skeleton. The skeleton provides ports for hoisting, securing, and transporting the enclosure, and is welded by corner fittings, columns, and cross beams.

2. Front panel

The front panels are the first surface visible to customers. Installation positions for devices such as the fire door, card reader, fire control panel, emergency door release button, and fire alarm horn strobe are designed on the front panels. The front panels are welded with the enclosure skeleton with 25 mm thick corrugated boards. A square pipe framework is reserved on the door installation position to ensure the strength.

3. Rear panel

The rear panels are opposite to the front panels and are deployed at the rear of the enclosure. The layout of the rear panels varies with products.

4. Side panel

There are two types of side panels: transport side panel and welded side panel. The transport side panels are secured to the enclosure using bolts to ensure the enclosure strength and protect equipment inside

the enclosure during transportation. They should be removed before combining enclosures onsite. Welded side panel are composed of corrugated boards. They are directly welded on the enclosure skeleton during fabrication. Installation positions for the fire door, cabling window, emergency door release button, and fire alarm horn strobe are reserved on the welded side panels as required.

5. Top panel

Top panels provide external protection for the entire enclosure to prevent the impact of external factors such as rains, snows, and sunlight on the building. Embedded parts welded at the top panels can be used to install and support overhead devices such as cable trays and the thermal insulation layer.

6. Bottom panel

The bottom panels of the enclosure are assembled by bottom cross beams for the standard enclosure at equal spacing. All cross beams are welded to the bottom side beams, and 4 mm thick steel plates are paved on the cross beams for securing and supporting equipment installation kits. The corrugated boards are welded under the cross beams, and rock wool is filled between two layers of steel plates to insulate heat, preserve temperature, and avoid condensation at the bottom of the enclosure.

7. Thermal insulation layer

Rock wool thermal insulation layers (rock wool + rock wool sandwich panels) are installed in the enclosure. With the overall thickness of no less than 100 mm and the rock wool density of 120 kg/m³, the thermal insulation layer can effectively insulate heat and preserve temperature for the enclosure. As the rock wool provides good waterproof performance, it can effectively protect equipment inside the enclosure in the case of fire.

8. Roof and façade

The module steel structure roof and façade should be provided for this project. Vendor should not mount / install any equipment on the roof top of the DRC building as NEA can scale the same building with third floor in future.

2.1.3.4 The Prefab Module dimension

The exposed plates of modules should be weathering steel plates commonly used for same with marine containers. Compared with common steel plates, the weathering steel plates have better anti-corrosion and coating performance. The weathering steel plates are coated with anti-corrosion paint in the factory, meeting the requirements for application in outdoor class C environments.

Two types of pre-fab module is combined to form a module building to provide all required function area rooms.

Figure 1-1 Wide module

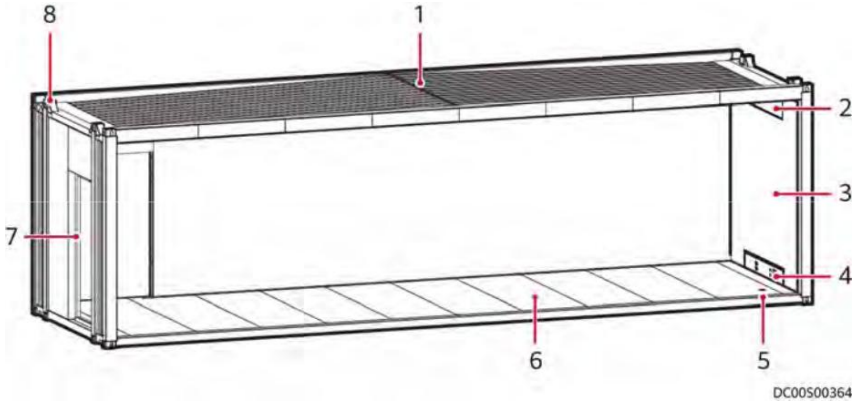
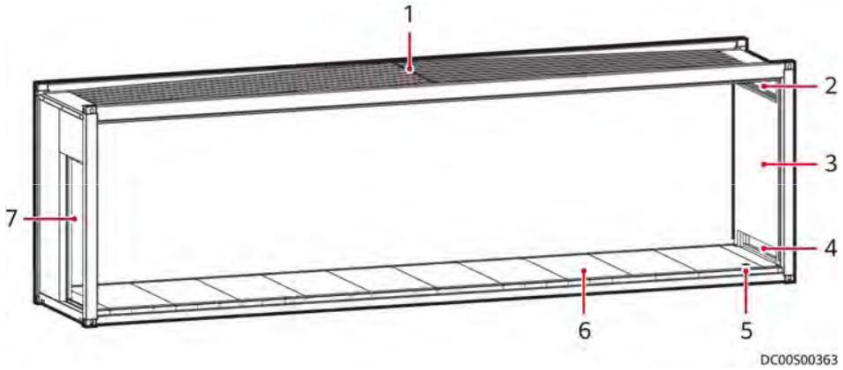


Figure 1-2 Standard module



(1) Sloping roof (top layers) or flat roof (other layers)
(2) Feeder window
(3) Rock wool wall
(4) Pipe routing hole
(5) Floor drain
(6) Steel floor
(7) Fireproof door
(8) Reinforced corner column

2.1.4 VRV/VRF Configuration Requirements

The scope comprises supply, installation, testing commissioning of air-conditioning by VRV/VRF system. The system to facilitate the operation & control of individual room other than data hall and power room (cooled by precision air conditioner).

The VRV/VRF air conditioning system should be multi-connected, and cooling capacity minimum 150kW, power input 380V/50 Hz, with DC variable frequency.

The system shall be able to cater the partial load which can be as low as 10% of the total load. Thereby the operation of indoor & outdoor units is minimized. The inverter-based scroll compressors/digital scroll compressor which has higher EER are employed in the VRV/VRF systems ensure trouble free operation. The drain point of each unit shall be connected to the common drain point. Proposed AC system will be microprocessor controlled inclusive of safety factor & gadgets.

The condensing units should provide cooling within ambient range of 5°C to 50°C DB & heating in the range of 0°C to 15°C DB. The outdoor unit should have a one DC Inverter scroll compressor and one constant speed scroll compressor.

All expose pipe to be covered with race way or heavy-duty flexible pipe for protection. Special precaution to be taken while, installing of the drain piping. The contractor shall be responsible for any leakage / seepage due to poor installation of HVAC drain till the guarantee period. Drain point to be tested for 24 hours after blocking one end. Drain piping will be plugged at both ends by appropriate method after completing the drain test to avoid chocking due to foreign material.

Noise level shall not be more than 72 dB (A) at normal operation measured horizontally 1m away and 1.5 m above ground. Control wiring from ODU to IDU shall be contractor's scope.

The refrigerant circuit shall have liquid and gas shut off valve or a solenoid valve at condenser end. All necessary safety devices shall be provided to ensure the safety operation of the system.
Refrigerant should be only R-410A.

To meet the fresh air requirements of the equipment container, an independent clean fresh air system is deployed in the equipment container area.

The fire extinguishing exhaust system must be installed in the area where gas fire extinguishing is used to exhaust the indoor fire extinguishing exhaust. The exhaust air volume is determined based on the number of ventilation times in the equipment container, which is greater than or equal to five times per hour.

All air conditioners and ventilation devices are linked with the fire extinguishing system.

2.1.5 Fire Extinguishing System

Pre-action fire sprinkler system (single interlock) shall be provided to protect the areas other than data hall, power room, and DRC equipment room.
Bidder is required to design, supply & install the sprinkler system based on local applicable codes and the following international fire codes and standards:

- NFPA 75: Standard for the Protection of Information Technology Equipment
- NFPA 13: Outlines the requirements for installing sprinkler systems.
- NFPA 2001: Clean Agent Fire Extinguishing Systems
- NFPA 12a: Standard on Halon 1301 Fire Extinguishing Systems
- NFPA 72: National Fire Alarm and Signaling Code
- NFPA 25: Inspection, Testing and Maintenance of Water Based Fire Protection Systems

2.1.6 Building water supply & Drainage System

For the building water supply system, GI pipes and fittings for water connections (internal& external water supply) shall be used.

Pipes shall be of medium/ heavy quality galvanized iron, screwed kited and shall conform to IS 1239 or international equivalent. All fittings shall be malleable iron galvanized fittings of approved best quality. The thickness of pipes shall conform to the table given below.

The details of GI pipes and sockets regarding nominal bore, thickness and weight in kg/m are given in the table. Reference code/ standards:

Dimensions of pipes			Dimensions of ordinary socket			
Nominal bore mm	Outside Maximum Mm	Diameter Minimum Mm	Thickness Mm	Approximate outside diameter Mm	Minimum length mm	Weight of pipe Kg/m
15	21.8	21.0	2.65	27.0	33	1.23
20	27.3	26.5	2.65	32.5	39	1.59
25	34.2	33.3	3.25	39.5	46	2.46
32	42.9	42.0	3.25	49.0	51	3.17
40	48.8	47.9	3.25	56.0	51	3.65
50	60.8	59.7	3.65	68.0	60	5.17
65	76.6	75.3	3.65	84.0	69	6.63
80	89.9	88.0	4.05	98.0	75	8.64
100	115.0	113.1	4.50	122.00	77	12.04

Table (Particulars of medium grade GI pipes)

Pipe Installation

1) Threaded pipe connection

Because of the plasticity of the steel, the pipe must be straightened before installation. Install the threaded pipe fittings in the direction of rotation at a time. Do not reverse them. After the installation, expose the 2 to 3 threads and remove the remaining packing. Do not expose the oil hemp. Protect the exposed thread from corrosion.

2) Pipe flange connection

If the pipe is connected to the flange or the flange valve, select the standard according to the design requirements and working pressure.

The flanges are parallel to each other and perpendicular to the middle line of the pipe. The length of the exposed nut of the screw is the same as that of the knot and is not greater than 1/2 of the diameter of the screw. The knots are on the same side. The gasket material meets the design and construction requirements.

3) Pipe welding

The grooves of the weldment with the wall thickness greater than or equal to 4 mm are of the V type. If the wall thickness is less than 4 mm, the I-shaped groove is used. The groove machine shall be used for pipe groove, and the surface of the groove shall be neat and clean. The unqualified pipe mouth shall not be welded. The pipe must be flush with the outer wall when it is aligned.

All welds are fully welded. After welding, remove the welding slag and oxide from the weld immediately. Mark the welder's mark immediately after each weld is welded.

4) PP-R pipe hot melt connection

After the power supply is connected and the operating temperature indicator is on, you can start the operation.

Cut the pipe with the end face perpendicular to the pipe axis. Generally, use a pipe shear or pipe cutter to cut the pipe. If necessary, use a sharp hacksaw to cut the pipe. After cutting the pipe, remove burrs and burrs from the end face.

The connection surface between pipes and fittings must be cleaned, dry, and oil-free. Pipes shall be clean and clean during installation. If hidden, stamping shall be performed. The pressure shall be in accordance with the specifications and design requirements.

Pipe thermal insulation

The thermal insulation of hot water and water supply pipes shall be strictly performed according to the design requirements.

1) Construction method and technical requirements

a. Pipeline insulation shall be performed after the pipe pressure test, water penetration, and anticorrosion are complete. Insulation of non-horizontal pipes is performed from bottom to top. Pipes shall be insulated tightly, especially tee, elbow, support and valve, flange and other parts shall be filled tightly.
b. Selection of pipes and plates:
c. Water pipes are made of thermal insulation materials. The inner diameter of the pipe is consistent with the outer diameter of the corresponding pipes.
d. The thermal insulation layer must be in good contact with the wooden support of the pipe hanger.
e. The thermal insulation materials are securely bonded. During the cutting process, the cross-section of the material is flat and the glue is evenly applied.
f. The thermal insulation layer must be jointed on the top of the pipe. Direct bends are recommended for thermal insulation. Do not use the method of cutting the horseshoe shape and bonding it for multiple times to repair the radian.

Sanitary ware installation

Material requirements:

The specifications and models of sanitary ware must meet the design requirements. And has a certificate of quality of the product. Sanitary ware appearance should be regular, shape, smooth surface, aesthetic, no cracks, smooth edges, consistent tone.
Sanitary ware parts should be standard, quality should be reliable, smooth surface, electroplating uniform, clear thread, and lock nut tightness moderate, no trachoma, cracks or other defects.
The water tank of sanitary ware shall be of water saving type. Other materials shall meet the requirements of material standards.

Operating conditions:
The pressure and water-closing tests of the pipes connected with sanitary ware should be completed, and the formalities of hidden pre-inspection should be completed. Other sanitary ware should be installed after the indoor decoration is completed. Sanitary ware should be inspected and cleaned before it is installed stably. Fittings and sanitary ware should be matched. Some sanitary ware should be carried out first.

Prefabricated and re-installed:

The model, specification and quality of sanitary ware must meet the design requirements. The joint between the outlet of sanitary ware drainage and the drainpipe socket must be tight. Prevent the cleaning kit from colliding with other components during transportation and installation. After the stable installation, the drain port of the sanitary ware should be blocked with protective articles and the chrome-plated parts

should be wrapped with paper to avoid blockage or damage. When picking holes in glazed tiles and terrazzo walls, it is advisable to use a hand drill or use a small chisel to lightly pick off the glaze first, and then pick up the ash layer under the bricks to prescribe the available force, but not too strong, in order to avoid shattering the surface layer or into empty drum phenomenon. After the fittings are installed stably, to prevent the fittings from being lost or damaged, the materials such as zippers and chain blocking and fittings should be installed before the completion of the construction. After installation of the sanitary ware should be protected to prevent the sanitary ware porcelain surface damage and the entire sanitary ware damage. Before the water-through test, check whether the floor drain is smooth and whether the household valve is closed. Then, perform the water-through test by floor and room to prevent the decoration project from being damaged due to water leakage. In winter when the indoors are not warm, all kinds of sanitary ware must be drained clean. There should be no water in the trap to avoid freezing and cracking of the sanitary ware and trap.

PVC drainage system

The following conditions shall be met before the construction and installation of pipeline engineering:
(1) The design drawings and other technical documents are complete, and the design entity shall perform design disclosure.
(2) The approved construction scheme or construction organization design has been made and technical disclosure has been made.
(3) The materials, construction force, water, electricity, and material storage and placement site where construction machines and tools enter the construction site can meet the construction requirements and ensure normal construction.
Before construction and installation, understand the structure of the building, and formulate measures for cooperation with civil engineering and other work types based on the design drawings and construction scheme. The installation personnel must be familiar with the performance of the PVC pipe and its auxiliary pipe fittings, master the basic operation requirements, and do not perform construction blindly.
The appearance of pipes and fittings and the tolerance of fittings should be carefully checked. The dirt and sundries on the exterior of pipes and fittings should be removed.

Installation of PVC pipe

(1) Pipes shall be laid only after the elevation at the bottom of the trench and the foundation quality of the trench are qualified.
(2) The sand foundation of the pipeline shall be made of course and medium sand without foreign matters such as grass roots and shall be tamped by layered watering.

(3) Reliable spreaders should be used for pipe lifting and lowering. When hoisting PVC pipes, use flexible suspenders or do not damage the PVC pipe devices. Single pipe and pipe section shall be smoothly trenched and shall not collide with trench or bottom.

(4) After the PVC pipe is aligned and the gradient meets the design requirements, the joints can be connected. After the PVC pipe is connected, the joints must not be disturbed.

(5) After the pipe installation is complete, perform the water filling test and water pressure test according to the specifications and design requirements.

2.1.7 Building Elevator

Bidder is required to design, supply & install the elevator based on local applicable codes and standards, key specification is as following,

Elevator type: Traction type cargo/passenger lift

Loading capacity: 2,000 Kgs

Travel stops: 2 (2 floors with 4.15m height per floor)

Travel speed: 1 m/s

Motor location: Top based machine room or as manufacturers recommended.

Car groups: only 1 car.

Car door size: 1400 mm (W) x 2400 mm (H)

Well size: as manufacturers recommended.

The elevator shall be equipped with emergency alarm and multi-party communication device, traction machine speed limit function, and light screen anti-clamping device.

2.2 Building interior decoration requirement (DRC office area)

Suspended ceiling:

The main equipment container uses a large keel and double-tube grille lamp belt, and the ceiling is painted with dust-proof paint.

All ceilings in this decoration project are made of metal ceiling plates. The ceiling back is equipped with dustproof sound-absorbing paper. Metal ceiling plate thickness of 0.8 mm, using the market with a good reputation of high-end products; The product must be beautiful, resistant to moisture and salt, strong adhesion, scratch, dust, fire, sound-absorbing performance, no harmful gas release, anti-corrosion and non-deformation, lower electromagnetic interference, easy to disassemble, soft tone, and no glare, no colour difference occurs after long-term use, and ensure that the fire resistance time is not less than 15 minutes.

Ground:

The floor of the equipment container is an antistatic raised floor with the dimensions of 600 x 600 and the height of more than 400 mm. The floor supports must be fixed on the floor using screws. The raised floor is under the floor and painted with dust-proof floor paint. Adjustable air exhaust panels are configured,

raised floor under the floor, four walls brush dust-proof floor paint. Use 20 mm thick aluminum foil and closed-bubble rubber-plastic thermal insulation board under the board of the main equipment container. Use a dam under the floor of the dedicated air conditioner area in the equipment container. Use JS waterproof measures on the floor of the dedicated air conditioner area in the dam. The rooms are all made of 60 high stainless-steel baseboards.

The ESD raised floor of this decoration project is 600 mm x 600 mm. The product must pass the EEC106 European Economic Community Directive 106 standard or international equivalent with strict performance and security tests. The fireproof performance is designed and tested according to the highest international fireproofing standard and has obtained the ISO 9001 quality system certificate. If the ESD movable floor has internal filling materials, the fireproof level A materials must be used. In addition, the centralized bearing capacity should not be less than 5500 N, and the distributed bearing capacity should not be less than 20,000 N/m2.
After the antistatic raised floor is installed, use stainless steel baseboards with a thickness of 2.0 mm or above to trim the edge of the joints.

Wall:

The equipment container uses light steel keel filled with 50-inch-thick thermal insulation rock wool, colour steel composite gypsum board veneer, 3000 mm high, and stainless-steel baseboard. Office rooms use latex paint walls and stainless-steel baseboards. The colour steel plate is dustproof, easy to clean, does not generate glare, has a strong structure, and is durable and environment friendly. In addition, the colour steel plate must meet the fireproof requirements. Is the market with a good reputation in high-grade products; the colour steel plate surface layer is the galvanized steel plate; the steel plate back sticks the paper surface gypsum board.

Doors and windows:
Fireproof glass doors are used on fireproof glass partitions, toughened glass doors are used on tempered glass partitions, and grade A steel fire doors are used as evacuation passages. The equipment container uses two fireproof steel doors as the external door of the emergency door. Ensure that the door complies with the fireproof specifications.

Partition:
High-fire-proof glass is used to block the office areas of the equipment container. Use toughened glass with a thickness of 12 mm or above as the glass partition. The glass partition under the antistatic raised floor and the upper part of the aluminium alloy suspended ceiling are fixed to the floor and the suspended ceiling surface by the structural steel frame. During the construction, pay attention to the fireproof and

blocking treatment of all partitions. The fire resistance time must be no less than 1.5 hours and comply with the international standards.

Furniture

Furniture should be designed for comfortable environment, a multi–step, elegant lacquer finishing.

Furniture mainly consists of the following: (Refer BoM)

- High back chair with armrest
- Reception table
- File cabinet for cabins
- Manager table
- Dust bins
- Wall clock
- Printer table
- Shoe rack
- Staging room table
- BMS room counter table
- Sanitary ware
- Any other required items

3. Operation and Maintenance Services (O&M)

Operation

Documentation of Standard Operating procedure for Power System Operations

a) Permit to work guideline creation.
b) Reengineering of business processes.
c) Redesign of standard operating procedures.
d) Preparation of operation safety manual.

Capacity building of Operational Staff

a) Operation training on DRC systems.
b) Training for protection co-ordination.

Maintenance

The maintenance of the DRC system under Operation and Maintenance (O&M) period shall be comprehensive, as set forth herein, in nature and would broadly include but not be limited to diagnosis and rectification of the hardware and software failures. The scope includes:

a) Co-ordination with equipment supplier for repair/ replacement of defective equipment's.
b) Configuration of the replaced hardware/software, periodic routine checking as part of a preventive maintenance program which would include checking of functionality of hardware and software.

The SI shall be required to provide the services to manage entire DRC, DWDM and NEA private cloud system installed & commissioned by SI for NEA in order that they have maximum availability to enable NEA to realize their desired business objectives.

a) System Management Services shall be provided by SI in order that maximum uptime and performance levels of installed NEA private cloud system is ensured. As such, SI is expected to provide services as per ITIL (IT Infrastructure Library) standards with performance levels meeting or exceeding those mentioned in Service Level Agreement (SLA) agreed between NEA and SI.

b) The SI shall develop NEA private cloud specific automated helpdesk (ticketing) tool to be able to log and resolve tickets pertaining to the NEA private cloud system. To achieve the desired Service Levels, the SI may need to interact, coordinate and collaborate with the other vendors of NEA. SI will act as the Single Point of contact for all issues relating to the Service Levels

c) Prime responsibility of providing desired services shall be that of SI during the project implementation. The duration of FMS shall be for 3 years which shall start immediately from the date of Enterprise-wide Go-Live at all locations.

d) The Facilities Management would, include following major areas of services.
   i) Ticket logging through Help Desk Services
   ii) Technical Support Services
   iii) SLA monitoring etc.

e) The SI shall provide adequate resources for supporting the above said services at the user locations. The Help Desk agents shall coordinate the assigning of user calls to FMS resources. An indicative number of resources required is mentioned in Minimum Resource requirements of this RFP.

f) SI shall provide the FMS agreed coinciding with the DC & DRC should run 24*7 but the business hours may be considered as 10:00 AM to 6:00 PM for submitted daily, Weekly and Monthly reports.

g) The SI shall submit a comprehensive FMS process, plan and deliverables for the entire NEA private cloud system including the field activities along with the proposal to NEA for approval

h) SI shall perform periodic health check-ups and troubleshooting of all the NEA private cloud systems and implement proactive rectification measures as required.

i) FMS Team: SI shall appoint FMS Helpdesk Coordinator of project in the FMS phase. FMS Helpdesk Coordinator will be single-point-of-contact for responding to all the queries from NEA or accepting its problem management requests. The FMS Helpdesk Coordinator would be stationed at Kathmandu at NEA DC. The helpdesk team shall be stationed at NEA DC. The space for setting up the helpdesk would be provided by NEA. All requisite infrastructure and resources required for smooth functioning of the FMS helpdesk would be provided by the SI at no extra cost to NEA.

j) The SI shall deploy sufficient and qualified, skilled manpower to carry out the FMS services at both DC and DRC location for the specified scope of work. It is imperative for the FMS staff to know the Tender and be able to deal with all the queries related to the NEA private cloud system. The SI shall ensure replacement in not more than 7 days of the FMS staff whose performance is not found satisfactory by the NEA.

3.1 Operations and Maintenance support for NEA private cloud system

SI shall provide Cloud platform Development and Maintenance / Support Services on an ongoing basis, especially in response to integration, data exchange along with requests for changes in the Cloud platforms through an ATS. Support in the area of software development and maintenance shall include:

a) Maintaining usage of deployed NEA private cloud platforms so as to ensure its effective day to day operational usage. The job includes support maintenance of all the Cloud platform modules along with system software's.

b) SI shall debug and fix the operational problems, perform error handling while running the cloud services during the project period.

c) SI shall generate additional reports and modify existing reports and queries, as per user's requirement.

d) SI shall provide hands-on assistance to the users to resolve any operational doubts as and when needed while the Cloud platform is in operation.

e) SI shall be responsible for Integration of deployed cloud platforms during the project period with other cloud platforms / systems.

f) SI shall document all the changes incorporated in the cloud platform software and improves the documentation of existing user / system reference manuals of different modules wherever it is necessary and possible.

3.2 Cloud Infrastructure Operations and Maintenance Services

SI shall carry out the below mentioned activities:

3.2.1 Resource Management Adequately size, provision and maintain the necessary compute, memory, and storage required, building the redundancy into the architecture (including storage) and load balancing to meet the service levels While the initial sizing and provisioning of the underlying infrastructure may be carried out based on the information provided in the Tender, subsequently, it is expected that the SI, based on the growth in the user load (peak and non-peak periods; year-on-year increase), will scale up or scale down the compute, memory, and storage as per the performance requirements of the solution and meet the SLAs.

a) In addition to scaling, for any major expected increase in the workloads, carry out the capacity planning in advance to identify and provision, where necessary, the additional capacity to meet the user growth and / or the peak load requirements to support the scalability and performance requirements of the solution.

b) The scaling up / scaling down (beyond the auto-scaling limits or whenever the auto scaling limits have to be changed) has to be carried out with prior approval by NEA. SI shall provide the necessary details including the sizing calculations, assumptions, current workloads and utilizations, expected growth / demand and any other details justifying the request to scale up or scale down.

3.2.2 Patch and Configuration Management manage the instances of storage, compute instances, and network environments. This includes Agency-owned and installed operating systems and other system software. SI is also responsible for managing specific controls relating to shared touch points within the security authorization boundary, such as establishing customized security control solutions. Examples include, but are not limited to, configuration and patch management, vulnerability scanning, disaster recovery, and protecting data in transit and at rest, host firewall management, managing credentials, identity and access management, and managing network configurations.

3.2.3 Cloud Security Administration

a) Appropriately configure the security groups in accordance with the Security policies.
b) Regularly review the security group configuration and instance assignment in order to maintain a secure baseline.
c) Secure and appropriately segregate / isolate data traffic/cloud platform by functionality using DMZs, subnets etc.
d) Ensure that the cloud infrastructure and all systems hosted on it, respectively, are properly monitored for unauthorized activity.
e) Conducting regular vulnerability scanning and penetration testing of the systems, as mandated by their Government Agency's policies.
f) Review the audit logs to identify any unauthorized access to the government agency's systems.

3.2.4 Monitoring Performance and Service Levels

Provide and implement tools and processes for monitoring the availability of assigned cloud platforms, responding to system outages with troubleshooting activities designed to identify and mitigate operational issues.

a) Reviewing the service level reports, monitoring the service levels and identifying any deviations from the agreed service levels.
b) Monitoring of service levels, including availability, uptime, performance, cloud platform specific parameters, e.g., for triggering elasticity, request rates, number of users connected to a service.
c) Detecting and reporting service level agreement infringements.
d) Monitoring of performance, resource utilization and other events such as failure of service, degraded service, availability of the network, storage, database systems, operating Systems, cloud platforms, including API access within the cloud service provider's boundary.

3.2.5 Backup

a) Configure, schedule, monitor and manage backups of all the data including but not limited to files, images and databases as per the policy finalized by Government Agency.
b) Restore from the backup where required.

3.2.6 Business Continuity Services

a) Provide business continuity services in case the primary site becomes unavailable.

3.2.7 Support for Third Party Audits

a) Enable the logs and monitoring as required to support for third party audits.

3.2.8 Miscellaneous

Prepare a comprehensive O&M plan for managing the cloud services and keep it updated with any changes during the course of the project. Create and maintain all the necessary technical documentation, design documents, standard operating procedures, configurations required to continued operations and maintenance of cloud services.

3.3 Storage and Backup Management

The SI shall perform backup as per the requirement of NEA. This will include installation of backup software, managing the tape library, regular backup and restore operations and assuring security of the media through appropriate access control. In addition, the SI shall also manage scheduled data replication. The activities shall include:

- Backup of operating system, database and cloud platform shall be performed as per stipulated policies of NEA at the data centre premises. The SI shall provide required tools for undertaking these activities.

- Monitor and enhance the performance of scheduled backups, schedule regular testing of backups and ensure adherence to related retention policies.

- Ensure prompt execution of on-demand backups of volumes, files and database cloud platforms whenever required by NEA or in case of upgrades and configuration changes to the system.

- Real-time monitoring, log maintenance and reporting of backup status on a regular basis. The administrators shall ensure prompt problem resolution in case of failures in the backup processes.

- The administrators shall undertake media management tasks, including, but not limited to, tagging, cross-referencing, storing, logging, testing, and vaulting in fireproof cabinets (onsite and offsite).

- The SI shall ensure the physical security of the media stored in cabinets.

- The SI shall also ensure that a 24 x 7 support for file, database and volume restoration requests is available at the data centres.

- The SI shall also provide sufficient media (tape library) for daily, weekly and additional backups for the duration of the contract.

3.4 Cloud Data Centre Operations

SI's responsibilities shall include the below but are not limited to;

a) Monitor, log & report entire equipment & module operation on 24x 7 x 365 basis.

b) Perform periodic health check-up & troubleshooting of all systems & modules installed by consortium members & implement proactive rectification measures.

3.5 Server Administration/ Management

SI's responsibilities shall include the below but are not limited to;

a) Provide the server administration and monitoring service to keep servers stable, operating efficiently and reliably.
b) Provide administrative support for user registration, creating and maintaining user profiles, granting user access and authorization, providing ongoing user password support, and providing administrative support for print, file, and directory, services.
c) Setting up and configuring servers.
d) Installation of the server operating system and operating system utilities.
e) Reinstallation on event of system crash/failures.

f) OS Administration for IT system.
g) Manage Operating system, file system and configuration.
h) Ensure proper configuration of server parameters, operating systems administration and tuning.
i) Regularly monitor and maintain a log of the performance monitoring of servers including but not limited to monitoring CPU, disk space, memory utilization, I/O utilization etc.
j) Regular analysis of events and logs.
k) Apply OS Patches and updates.
l) Monitor & verify logs files and periodically clean up log files.
m) Ensure proper running of all critical services on the servers. Schedule and optimize these services.
n) Maintain lists of all system files, root directories and volumes.
o) Resolving all server related problems.
p) Escalating unresolved problems to ensure resolution as per the agreed SLAs.
q) Responsible for periodic health check of the systems, troubleshooting problems, analysing and implementing rectification measures.
r) Logical access control of user and groups on system.
s) Responsible for managing uptime of servers as per SLA3.

3.6 Backup/Restore Management

SI shall perform backup and restore management in accordance with mutually agreed to backup and restore policies and procedures, including performance of daily, weekly, monthly quarterly and annual backup functions (full volume and incremental) for data and software maintained on Servers and storage systems including interfacing with NEA's specified backup media storage facilities.

SI's responsibilities shall ensure the below but are not limited to;

a. Backup and restore of data in accordance to defined process / procedure
b. 24 x 7 support for file & volume restoration requests
c. Maintenance and Upgrade of infrastructure and/or software as and when needed
d. Performance analysis of infrastructure and rework of backup schedule for optimum utilization
e. Generation and publishing of backup reports periodically
f. Maintaining inventory of onsite tapes
g. Forecasting tape requirements for backup
h. Ensuring failed backups are restarted and completed successfully within the backup cycle
i. Monitor and enhance the performance of scheduled backups
j. Real-time monitoring, log maintenance and reporting of backup status on a regular basis
k. Management of storage environment to maintain performance at optimum levels
l. Periodic Restoration Testing of the Backup

m. Periodic Browsing of the Backup Media
n. Management of the storage solution including, but not limited to, management of space, volume, RAID configuration, configuration and management of disk array, SAN fabric / switches, tape library etc.
o. Interacting with Process Owners in developing / maintaining Backup & Restoration Policies / Procedures
p. To provide MIS reports as per agreement 1.1.9 Messaging System management SI will provide management of messaging systems, including administration of messaging servers and monitoring performance.

3.7 Service Delivery Management

SI shall provide detailed description for service delivery management for the complete project plan and deliverables and project management methodology.

a. Project Management

i) SI will assign a Project Manager who will provide the management interface facility and has the responsibility for managing the complete service delivery during the contractual arrangement between NEA and the SI.

ii) Project Manager will be responsible for preparation and delivery of all monthly/weekly reports as well as all invoicing relating to the service being delivered.

iii) Project Manager's responsibilities shall essentially cover the following:

- Overall responsibility for delivery of the Statement of Work/s (SOW) and Service Level Agreement (SLA).
- Act as a primary interface to NEA for all matters that can affect the baseline, schedule and cost of the services project.
- Maintain project communications through NEA's Project Leader.
- Provide strategic and tactical recommendations in relation to technology related issues.
- Provide escalation to SI's /NEA's senior management if required.
- Resolve deviations from the phased project plan.
- Conduct regularly scheduled project status meetings.
- Review and administer the Project Change Management with NEA Project Leader.
- Identify and resolve problems and issues together with NEA's Project Leader.
- Responsible for preparation and delivery of all weekly/quarterly/monthly reports as well as all invoicing relating to the services being delivered.

3.8 Help Desk

Help Desk shall act as a single-point-of-contact for all service problems pertaining to software & network. The SI shall create and maintain a dedicated centralized online Help Desk specific to NEA private cloud operations with a telephone number, E-mail and call tracking mechanism that will resolve problems and answer questions that arise from the use of the offered solution as it is implemented at NEA. Users can log the queries / complaints, which shall be resolved as per the Service Level requirements. The helpdesk queries / complaints can be related to connectivity, messaging, security, Software, configuration and any other issues that arise in the NEA private cloud system.

Help Desk software shall take care of classification, automatic escalation, management, and status tracking and reporting of incidents as expected by the service level requirements. Status tracking shall be available to users through telephone number as well as online through software.

a) The Help Desk will respond to and resolve the problems as per the SLA.
b) Problems shall be classified into various levels of priority mentioned in the SLA. The assigned priority for each problem shall depend upon.
i) The extent of the problem's impact on the usability of the system.
ii) The percentage of users affected by the problem.
c) The initial assignment of priorities is the responsibility of the Help Desk's Problem Manager on basis of SLA. However, NEA can change the priority assigned to a particular problem and the procedures that exist for escalating a problem to progressively higher management levels, until agreement is secured.
d) The precise definition of problem priorities shall be documented in the SI's SLA.
e) Helpdesk shall troubleshoot on systems, cloud platforms (software), network, cloud services related issues, multimedia related issues, server administration, security policies, 3rd party coordination etc.
f) After problem resolution, the logged problem in help desk will be closed and notification will be sent to user for confirmation and rate the customer service on defined parameter in helpdesk.
g) Help Desk shall be responsible for change management like schedule up gradation of software components, cloud service components etc. Help Desk will co-ordinate and take approval from NEA for the same and will inform all users for such event in advance.
h) Help Desk shall also be responsible for managing problems/incidents related to network link at each Data Centre location, offices and HQ. Help Desk shall ensure timely response and assigning the problem/incident on priority basis. Help Desk shall be ITIL compliant & shall implement ITIL compliant help desk processes like Change Control & management Procedure, Incident & Problem management approach etc. SI shall utilize help desk tools, which are ITIL complaint and are open for integration with other enterprise management tools like EMS/NMS system etc. Following are the SI's Responsibilities regarding Help Desk:

A. NEA private cloud solution Services

a) Provide Level One Support for NEA private cloud solution, including incident logging, assigning incident numbers and dispatching the appropriate support personnel to remedy a problem.

b) Prioritize problem resolution in accordance with the severity codes and Service Levels specified.

c) Provide system status messages, as requested.

d) Maintain the defined help desk operational procedures.

e) Notify designated personnel of failure of any component of NEA private cloud solution, or of an emergency.

f) Initiate a problem management record ("PMR") to document a service outage to include (for example) date and time opened, description of symptoms, and problem assignment (Level Two/Level Three), and track and report on problem status, as required.

g) Monitor problem status to facilitate problem closure within defined Service Level criteria or escalate, as appropriate.

h) Monitor PMR closure, including documented problem resolution.

i) Provide NEA with complete and timely problem status through the problem tracking system, as requested.

j) Maintain an updated help desk personnel contact listing.

B. Management Services

a) Provide "ownership-to-resolution" of all help desk calls, monitor and report on the progress of problem resolution, confirm resolution of the problem with the End User, and log the final resolution via the problem management system.

b) Analyse and report on calls received by the help desk, including

i) Call volumes and duration,

ii) Incident & Problem trends,

iii) Call resolution time.

c) Assign priorities to problems, queries, and requests based on the guidelines/SLA provided by NEA.

d) Monitor and report to NEA on maintenance performance.

e) Provide input to NEA on End User training requirements based on help desk call tracking and analysis.

f) Update contact list of users initially provided by NEA.

B. Install/MAC Services (Install Move Add Change)

a) Act as the point-of-contact for install and MAC requests and status.

b) Act as the interface for coordinating and scheduling all installations and MACs.

D. User oriented Services

a) Provide an interface for user requests, such as new user IDs, address changes, routing requests, and password changes.

b) Advise the End User to take reasonable steps to backup information, if possible, prior to attempting to affect a resolution either by phone or hands-on during Desk Side Support Service.

Following is the NEA Responsibilities regarding Help Desk:

a) The NEA shall help SI to define the help desk call prioritization guidelines.

3.9 Vendor Management Services

As part of this activity the SI's team will:

a) Manage the vendors for escalations on support.

b) Logging calls and co-ordination with vendors.

c) Vendor SLA tracking.

d) Maintain database of the various vendors with details like contact person, Tel. Nos., response time and resolution time commitments. Log calls with vendors Coordinate and follow up with the vendors and get the necessary spares exchanged.

e) Analyse the performance of the vendors periodically (Quarterly basis).

f) Provide MIS to NEA regarding tenure of completion of ATS with outside vendors for the NEA private cloud in order that NEA may take necessary action for renewal of ATS. SI shall also provide MIS regarding performance of said vendors during existing ATS.

g) NEA shall provide SI with contact details of individual vendors.

3.10 Endpoint detection response (EDR) Management

This Service includes virus detection and eradication, logon administration and synchronization across servers, and support for required security classifications.

3.11 Network Monitoring & Management

This service provides for the Availability Monitoring of the network environment. Management includes proactive monitoring and management.

SI's Responsibilities shall include:

a) Provide a single-point-of-contact for responding to NEA's network management queries or accepting its problem management requests. SI's network management specialist will respond to NEA's initial request within agreed service level objectives set forth.

b) Monitor availability & escalate to NEA team and Notify NEA for network Outages.

c) Review the service levels of the Network fiber connectivity (as per pre-defined schedules on SLA performance) along with NEA.

d) Provide network availability incident reports severity wise to NEA in a format mutually agreed.

e) Provide SLA performance management network availability.

f) System performance is to be monitored independently by the SI and a monthly report mentioning Service up time etc. is to be submitted to NEA. The report shall include:

i) Network configuration changes

ii) Network uptime

iii) Latency report (both one way and round trip) times

iv) Historical reporting for generation of on-demand and scheduled reports of network metrics with capabilities for customization of the report presentation v) Generate SLA violation alarms to notify whenever an agreement is violated or is in danger of being violated.

g) Any other reports/format other than the above-mentioned reports required by NEA.

h) The SI shall monitor the network on a continuous basis using the NMS provided by network service provider and submit reports on a monthly basis with instances from the NMS system.

3.12 Service Management Controls

3.12.1 Incident Management

The SI must have:

a) Ability to create an incident record to document a deviation from an expected standard of operation.

b) Ability to create other ticket from the incident, if resolving the incident involves creating a service request, problem or work order.

c) Incident could be created automatically from sources such as email, system monitoring tools.

d) Ability to have ticket template containing data that agent can automatically insert in common, high-volume records. Instead of manually entering standard information each time, SI can apply a template that contains information such as owner, service group, service, classification, internal priority, activities, labour requirements, and activity owners.

e) The template can add the following information, but can be modified to include Priority, Owner or Owner Group, Service Group or Service, Classification; for Activities: Activity, Sequence, Job order, Site, Organization, Description, Owner or Owner Group, Priority, Vendor and Classification.

f) Ability to assign ownership of an incident either to a person or a person group who is responsible for managing the work associated with that record.

g) Ability to assign ownership via workflow or an escalation process.

h) Ability to associate an asset for an Incident record, if the issue you are reporting or working on involves an asset.

i) Ability to view a list of related records and view the work and communication logs for all related records on one screen, on the global record.

j) Ability to create a service request from an incident with a relationship between the two records.

k) Ability to create a Problem from Incident cloud platform to record an unknown, underlying cause of one or more issues.

l) Ability to create a release in the Incident cloud platform when resolving the Incident involves releasing a set of bundled changes to users.

m) Ability to relationships between Incidents.

n) Ability to identify a global incident, which is the root cause of many other issues or that is something affecting many users.

o) Ability to automatically assign one or more SLAs via Workflow or Escalation process based on SLA's criteria.

p) Ability to apply an incident template which contains activities that can be viewed and edited.

q) Ability to find and attach Solution record containing information on resolving to an Incident record.

r) Ability to record Solution containing information on the symptom, cause and resolution.

s) Ability to create and submit a draft solution from the Incident cloud platform screen which an agent can approve the solution for general use later.

t) The communication log stores inbound and outbound messages and attachments sent between users and agents.

u) Ability to view communication entries associated with a record.

v) Ability to use a communication template to fill in default data.

3.12.2 Ticketing Management

a) Ability to specify an Owner or Owner Group and Service Group or Service for the ticket.

b) Ability to specify a Classification for the ticket.

c) Ability to specify both a Reported Priority and an Internal Priority for the ticket.

d) Ability to list related assets on a ticket.

e) Ability to track time spent on a ticket.

f) Ability to apply one or more service level agreements (SLAs) to a ticket.

g) Provide Self-Service Service Requests module to allow users to submit and view service requests.

h) Ability to create other ticket from the service request, if resolving the service request involves creating an incident, problem, or work order.

i) Ability to relate existing tickets to the service request.

j) Service requests could be created automatically from sources such as email, system monitoring tools.

k) Ability to add a classification to enable workflow processes, escalations, and service level agreements.

l) Ability to have ticket template containing data that agent can automatically insert in common, high-volume records. Instead of manually entering standard information each time, agent can apply a template that contains information such as owner, service group and service, classification, and internal priority. The template can add the following information, but you can modify it; Priority, Owner or Owner Group, Service Group or Service, Classification, Vendor, and Organization.

m) Ability to assign ownership via workflow or an escalation process

n) Ability to select related asset by hierarchical view

o) Ability to filter the related asset list by value list: All, Public, or User/Custodian. The default User/Custodian is the affected person specified on the record.

p) Ability to show similar tickets to search for and relate other tickets to the current record. The purpose is for information only.

q) Ability to automatically assign one or more SLAs via Workflow or Escalation process based on SLA's criteria.

3.12.3 Problem Management

The SI must develop an effective problem management system to reduce the impact of problem that occur and minimize its reoccurrence. It shall help in identifying the root cause of the problem and proper recording and tracking of the problem till its resolution. In order systematically capture, record, track and resolve the calls, robust cloud platform tools with following functionalities / features shall be provided. The tools shall have following features:

a) Ability to apply a template to a Problem. The template contains common data such Priority, Owner or Owner Group, Service Group or Service, Classification, Vendor and Organization.

b) The Problem template also can contain activities, labour requirements, and activity owners.

c) The Problem template also can contain Problem activity common data such as, Sequence number, Job Plan, Site, Organization, Description, Owner or Owner Group, Priority, Vendor, and Classification.

d) Ability to associate an asset for a Problem record, if the issue you are reporting or working on involves an asset.

e) Ability to select related asset by hierarchical view.

f) Ability to relate other tickets and work orders to a Problem.

g) Ability to show similar tickets to search for and relate other tickets to the current record.

h) Ability to show similar tickets, Problems to search for and relate other tickets, Problems to the current record.

i) The similar ticket search results only list service requests, incidents, and problems having the same Classification. Records are not included in the results if they either are global records or history records.

j) Ability to identify a Problem as global record. A global record captures information about an issue affecting many people. The record might be a created for a shared asset i.e., the root cause of many other issues, such as a failed network server.

k) Ability to relate a Problem to a Global record.

l) Ability to create a service request from a problem, creating a relationship between the two records.

m) Ability to create a Release in the Problem cloud platform when resolving the Problem involves releasing a set of bundled changes to users. The created Release will be related to the originating Problem.

n) Ability to identify a global Problem, which is the root cause of many other issues or that is something affecting many users. A global record might have many other records related to it.

o) Ability to automatically assign one or more SLAs via Workflow or Escalation process based on SLA's criteria.

p) When you apply an SLA that includes a response commitment to a Problem, value in the Target Start date field is set based on that SLA .and when an SLA that includes a resolution commitment to a Problem, value in the Target Finish date field is set based on that SLA.

q) Ability to relate existing service requests, incidents and problems to a global record and manage them via the global record.

r) Ability to manage the tickets via the global ticket, when linked with global relationships, so the statuses of related tickets can be changed by changing only the status of the global record.

s) Ability to change status of each activity individually.

t) Ability to apply a template, which contains activities that can be viewed and edited.

u) Ability to select labour for activities on a Problem.

v) Ability to report labour time either for a Problem as a whole, for activities on the Problem, or for both types of labour time.

w) Ability to enter start and stop times.

x) Ability to select an owner for each Activity individually.

y) Ability to find and attach Solution record containing information on resolving to a Problem record.

z) Ability to record Solution containing information on the symptom, cause, and resolution.

aa) Ability to create and submit a draft solution from the Incident cloud platform screen which an agent can approve the solution for general use later.

bb) Ability to use the Work Log in the Problem cloud platform to document work that needs to be done or that was done to resolve the issue.

cc) Ability to modify or delete Work Log with authorization protected.

dd) Ability to create Communication action in Problem cloud platform to send communications about a record to a requestor or other user.

ee) Ability to use a communication template to fill in default data, such as the identifier, subject from the originating record when create a communication.

3.12.4 Performance Management

The recording, monitoring, measuring, analysing, reporting, and forecasting of current levels, potential bottlenecks, and enhancements of performance characteristics for the services, networks, cloud platforms, system software, and equipment within the scope shall be required. System tuning and optimization is an inherent part of this contract. Where warranted, the NEA private cloud SI will utilize capacity management data in combination with performance management data to identify ways to improve performance levels of the resources, extend their useful life, and request NEA to approve revisions/upgrades to the computing and communications hardware, software and other equipment such that higher levels of performance of the resources are obtained.

3.12.5 Capacity Management

The continuous monitoring, periodic analysis, and forecasting of the changes necessary to quantify capacity and configuration of finite resources comprising the computing and hardware/software (cloud) infrastructure supported under this initiative by the SI. Categories of resources to be capacity managed include but are not limited to servers & system software.

3.12.6 Security Management

The protection from unauthorized usage, detection of intrusions, reporting as required and proactive prevention actions are to be provided by the SI.

3.12.7 Resources for Project and Service Management

As mentioned in Minimum resource requirement section in the Tender.

3.13 Preventative Maintenance Activity

The preventive maintenance activities shall be performed by the SI to keep the system running at optimum level by diagnosis and rectification of all NEA private cloud system failures and would broadly include:

a. Configuration routine checking as part of a preventive maintenance which would include checking of functionality NEA private cloud system software.
b. Monitoring of the performance of the system and doing necessary tuning for optimum performance to accommodate any changes such as addition of new components.
c. Providing all necessary assistance to NEA for addition and modification of database and user interface & consumer portal displays and Database sizing activities.
d. Take Backup of the system at regular interval.
e. Restoration of the systems upon its failure and to restore the functioning of the various systems.
f. The Contractor should ensure Repair / replacement of defective equipment as per SLA.
g. The Contractor should ensure Configuration of the replaced hardware and software with periodic routine checking as part of a preventive maintenance program.
h. The Contractor should ensure proper monitoring of the performance of the system and doing necessary tuning for optimum performance to accommodate any changes such as addition of new components.

3.14 Service Delivery Management

SI shall provide detailed description for service delivery management for the complete project including transition plan and deliverables and project management methodology.

3.15 Project Management

SI will assign a Project Manager who will provide the management interface facility and has the responsibility for managing the complete service delivery during the contractual arrangement between NEA and the SI. Project Manager will be responsible for preparation and delivery of all monthly/weekly reports as well as all invoicing relating to the service being delivered.

Project Manager's responsibilities should essentially cover the following:

a) Overall responsibility for delivery of the Statement of Work/s (SOW).
b) Act as a primary interface to utility for all matters that can affect the baseline, schedule and cost of the services project.
c) Maintain project communications through utility's project leader.
d) Provide strategic and tactical recommendations in relation to technology related issues.
e) Provide escalation to SI's senior management if required.
f) Resolve deviations from the phased project plan.
g) Conduct regularly scheduled project status meetings.

h) Review and administer the project change control procedure with utility project leader.

i) Identify and resolve problems and issues together with utility project leader.

j) Responsible for preparation and delivery of all monthly reports as well as all invoicing relating to the services being delivered.

k) Fault detection and notification: The SI shall diagnose problems that could arise as part of the LAN/WAN network. These include connectivity problems due to failures in communication transport links, routing configuration points, or from software bugs etc.

l) Fault isolation and resolution: All faults that have been identified need to be isolated and rectified appropriately. The resolution measures undertaken by the SI and results produced accordingly shall be documented in the report.

m) Carrier coordination: Carrier coordination implies providing a single point of contact to resolve network related problems involving carrier circuits, whether equipment or circuit related. When a problem is diagnosed because of a WAN circuit, the SI must coordinate with the corresponding carrier to test and restore the circuit. The SI must take the responsibility and ensure that the problem is resolved.

n) Hardware/Software maintenance and monitoring: This would include problem determination, configuration issues, and hardware and software fault reporting and resolution. All such issues would need to be recorded and rectified.

o) 24x7 network monitoring and reporting:

The SI shall monitor the network on a continuous basis using the NMS and submit reports on a monthly basis with instances from the NMS system. System SI is to be monitored independently by the SI and a monthly report mentioning Service up time etc. is to be submitted to utility. The report shall include:

i. Network configuration changes
ii. Network performance management including bandwidth availability and bandwidth utilization
iii. Network uptime
iv. Link uptime
v. Network equipment health check report
vi. Resource utilization and faults in network
vii. Link wise latency report (both one way and round trip) times.
viii. Historical reporting for generation of on-demand and scheduled reports of business service-related metrics with capabilities for customization of the report presentation.
ix. Generate SLA violation alarms to notify whenever an agreement is violated or is in danger of being violated.
x. Any other reports/format other than the above-mentioned reports required by utility.

Install, Moves, Adds, and Changes (IMAC) services

This service provides for the scheduling and performance of install, move, ads, and change activities for hardware and software. Definitions of these components are as follows:

Install: Installation of optical fiber connections, desktop machines/workstations, servers, peripheral equipment, and network- attached peripheral equipment.

Move: Movement of optical fiber connections, desktop machines/workstations, servers, peripheral equipment, and network- attached peripheral equipment.

Add: Installation of additional optical fiber connections, hardware /software after initial delivery.

Change: Upgrade to or modification of optical fiber connections, existing hardware or software on desktop/workstations and servers etc.

Requests for IMAC shall be prepared by SI depending on customer/ system requirements & shall be approved by utility. Utility shall formulate guidelines for IMAC & communicate it to SI. All procurements shall be done by utility.

3.16 Contract management services

As part of this activity, for efficient and effective warranty implementation, the SI's team will:

a) Manage the vendors for escalations on support.
b) Logging calls and co-ordination with vendors.
c) Vendor SLA tracking.
d) Management of assets sent for repair.
e) Maintain database of the various vendors with details like contact person, tel. nos., response time and resolution time commitments. Log calls with vendors, coordinate and follow up with the vendors and get the necessary items exchanged.
f) Analyze the performance of the vendor periodically (quarterly basis).
g) Provide MIS to utility regarding tenure of completion of warranty/AMC with outside vendors for software, hardware & networks maintenance in order that utility may take necessary action for renewal of warranty/AMC. SI shall also provide MIS regarding performance of said vendors during existing warranty/AMC.

3.17 Restoration of data centre in case of failure

The SI shall ensure that all the relevant data is being transferred from data Centre at regular frequency to Disaster Recovery Centre (DRC) which are required for restoration of data Center in case of complete failure of the data Centre.

The SI shall carry out system build in order to build the data Centre from scratch utilizing DR Centre.

3.18 Performance monitoring and reporting

The contractor must adhere to well-defined processes and procedures to deliver consistent quality services throughout its contractual period. Any hardware/software to meet the requirements under this section must be provided by the contractor. The contractor is expected to have the following system management controls in place:

a) Availability management

The SI must define the processes/procedures which ensure the service delivery as per the required SLAs or exceed it. It should cover various equipment's such as all the servers, networks, switches, routers, modems & other site-specific services, and the critical services and their supporting hardware, and software components, as defined in scope of work. Industry standard SLA management tools should be deployed and shall have following essential features:

a) Ability to create an escalation for an SLA.
b) Ability to workflow the SLAs.
c) Ability to create new action types, if needed.
d) Ability to define sets of actions that are grouped together in a specific sequence.
e) Ability to associate an escalation point with one or more actions through the action group.

b) Security management

The protection from unauthorized usage, detection of intrusions, reporting as required and proactive prevention actions are to be provided by the SI.

c) Performance management

The recording, monitoring, measuring, analyzing, reporting, and forecasting of current levels, potential bottlenecks, and enhancements of performance characteristics for the services, networks, applications, system software, and equipment within the scope shall be required. System tuning and optimization is an

inherent part of this contract. Where warranted, the contractor will utilize capacity management data in combination with performance management data to identify ways to improve performance levels of the resources, extend their useful life, and request utility to approve revisions/upgrades to the computing and communications hardware, software and other equipment such that higher levels of performance of the resources are obtained.

3.19 Service management tools

The SI must adhere to well-defined processes and procedures to deliver consistent quality services throughout its contractual period. Any hardware/software to meet the requirements under this section must be provided by the SI. The SI is expected to have the following system management controls in place.

Emergency support

The severity levels are defined under clause emergency support for severity 1 issues are to be provided 24 hours a day, seven days a week. The on-call support team shall include all key technical competencies so that any aspect of a system failure can be attended. The emergency support service goal is to meet the availability targets greater than specified in this document. Resolution of problems may also be provided by an individual fix that will be installed by the SI at no extra cost to Utility.

Problem Severity Levels

The problems will be categorized as follows:

Category	Definition
Severity 1 – Urgent	Complete system failure, severe system instability, loss or failure of any major subsystem or system component such as to cause a significant adverse impact to system availability, SI, or operational capability.
Severity 2 – Serious	Serious Degradation of services or critical functions such as to negatively impact system operation. Failure of any redundant system component such that the normal redundancy is lost, non-availability of manpower at DRC, NOC during working hours.
Severity 3 – Minor	Any other system defect, failure, or unexpected operation.
Severity 4 – General/technical help	Request for information, technical configuration assistance, “how to” guidance, and enhancement requests.

Problem/Defect Reporting Procedure

The Contractor shall propose an appropriate problem/defect reporting procedure to meet the requirement of all severity level cases along with the offer.

Response and Resolution Time

This clause describes the target times within which the SI should respond to support requests for each category of severity. The Initial response time is defined as the period between the initial receipt of the support request (through approved communications channels) and the acknowledgment of the SI. The action resolution time is the period between the initial response and the SI delivering a solution. This period includes investigation time and consideration of alternative courses of action to remedy the situation. The action is defined as a direct solution or a workaround.

Except for Severity Level 1, all hours and days specified are working hours only.

	Severity	Initial Response Time	Action Time	Resolution Action
1		30 mins	2 hours	An urgent or emergency situation requiring continuous attention from necessary support staff until system operation is restored – may be by workaround.
2		1 day	2 days	Attempt to find a solution acceptable to Utility/ Employer as quickly as practical. Resolution time is dependent on reproducibility, ability to gather data, and Utility prioritisation. Resolution may be by workaround.
3		2 days	5 days	Evaluation and action plan. Resolution time is dependent on reproducibility, ability to Gather data, and Utility prioritisation. Resolution may be by workaround.
4		2 days	10 days	Report on the problem/query is to be furnished.

The SI shall submit the detailed format/procedure for all the activities such as Reporting time, Resolution time, Downtime etc. along with the offer.

Preventive Maintenance

The SI shall undertake preventive maintenance of all equipment/modules, under the scope of this contract, in accordance with this section. The SI will prepare the report as per periodicity defined below and submit the same to the engineer-in-charge. Activities shall include but not limited to:

- Average and peak usage of CPU, LAN, memory and disk –once every month.
- Monitoring of machine with reference to error reports and logs - once every week.

- Online diagnostics for servers and workstations - once every 3 months.
- Connection test of LAN cables for identifying potential loose contacts in machines, hubs and routers - once every 3 months.
- Physical hardware checks to ensure proper working of cooling fans etc.- once every 3 months.
- Physical inspection to check the machines and the panels for rat droppings, lizards or other vermin - once every 3 months,
- Cleaning and blowing for removal of dust from servers, workstations etc.- once every 3 months.

Exclusions:

- Maintaining dust free environment and protection from rodents and vermin is the responsibility of Utility.
- Regular cleaning of computer furniture and surroundings is the responsibility of utility.
- Equipment shutdown during preventive maintenance shall be deemed as available.

3.20 SI's obligation

- The SI shall be responsible to establish proper connection between data Centre and disaster recovery Centre at all-time up to a period of 3 years after the date of Go Live of DRC. It includes the responsibility of monitoring, adding, replacing, maintaining and upgrading of the optical fiber connections between data Centre and disaster recovery Centre with proper coordination with concerned offices of NEA.
- The SI shall ensure that all components (hardware &software) covered under AMC/ATS are maintained in good working condition and in case of any defect, timely replacement/repair shall be carried out so as to meet the availability requirements specified herein.
- The SI will submit FSR (Field Service Report), and the steps taken to solve the problem, along with details of code changes.
- Fault detection and notification: The SI shall diagnose problems that could arise as part of the LAN/WAN network. These include connectivity problems due to failures in communication transport links, routing configuration points, or from software bugs etc.
- Fault isolation and resolution: All faults that have been identified need to be isolated and rectified appropriately. The resolution measures undertaken by the SI and results produced accordingly shall be documented in the report.
- Carrier coordination: Carrier coordination implies providing a single point of contact to resolve network related problems involving carrier circuits, whether equipment or circuit related. When a problem is diagnosed because of a WAN circuit, the contractor must coordinate with the corresponding carrier to test and restore the circuit. The contractor must take the responsibility and ensure that the problem is resolved.
- 24x7 network monitoring and reporting: The contractor shall monitor the network on a continuous basis using the NMS and submit reports on a monthly basis with instances from the NMS system. System

SI is to be monitored independently by the contractor and a monthly report mentioning Service up time etc. is to be submitted to Utility. The report shall include:

- Network configuration changes
- Network SI management including bandwidth availability and Bandwidth utilization
- Network uptime
- Link uptime
- Network equipment health check report
- Resource utilization and faults in network
- Link wise latency report (both one way and round trip) times.

- Historical reporting for generation of on-demand and scheduled reports of business service-related metrics with capabilities for customization of the report presentation.
- Any other reports/format other than the above-mentioned reports required by NEA.

3.21 Responsibility of utility

- Utility shall ensure that proper environmental conditions are maintained for the system.
- Utility shall ensure that the system is kept and operated in a proper and prudent manner and only trained utility employees (or persons under their supervision) are allowed to operate the system.
- Utility shall provide access to the sites of installation for purposes of providing support services.

3.22 DC/DRC area and other area

- The SI should consider the below manpower for operation and maintenance,

SN	Operation and maintenance manpower	General	1st Shift	2nd Shift	3rd Shift
1	Disaster recovery centre supervisor	Yes			
2	Multi skilled technician		Yes	Yes	Yes

This is minimum indicative list of resources and based on actual requirements SI may deploy any number of resources to meet the SLA.

- NEA shall not pay any cost for additional resources deployed for compliance of SLA and completion of scope of work in due time. In case deployed manpower is not available or on leave, bidder is required to provide the replacement personnel with same or higher technical capabilities of the non-available personnel.
- The bidder should submit the methodology and manpower plan for operation & maintenance along with technical proposal.
- All local labor compliances must be adhered for the O&M employees.

- The bidder has to consider adequate extra manpower for roistering purpose. At any point of time the site must have 2 resources in each shift.

Minimum Qualification Criteria for Manpower

Sr. No	Type of manpower	Minimum qualification
1	Site supervisor	Diploma in Electrical/Electronics/Instrumentation/mechanical with 7 years of total experience with minimum 3 years of experience in managing physical infrastructure of datacentre disaster recovery centre.
2	Multi Technician	Diploma in Electrical/Electronics/Instrumentation/mechanical with 4 years of total experience with minimum 2 years of experience in managing physical infrastructure of datacentre or disaster recovery centre.

4. Service Level Agreements (SLA)

The SI shall provide guaranteed availability for various types of severity levels in disaster recovery centre and DC-DR connection. The non-availability hours for availability calculation may be reckoned from the end of the allowed action resolution time. This process should be fully automated and SLA report should be system generated and selected bidder should provide necessary tools.

Severity level, time of reporting to the contractor support engineer/support centre pursuant to the appropriate methods in the agreement, allowed response time as per the response times defined in clause 3.19, actual resolution time, and signature of engineer-in-charge as well as the SI's support engineer of the site. Duration of outages over and above the action resolution time in each of the severity levels shall be counted for the non- availability computation and shall be clearly brought out in the register. The resolution may be accomplished by a work around, and such solution shall mark the end of non-availability. In the event of multiple failures at a site, due to a common cause, the first FPR (Field Problem Report) logged shall be used for availability calculation. However, simultaneous multiple outages due to unrelated cause would be counted separately.

4.1 Penalty Applicable during Implementation Period

The rollout of DR System including all the hardware/software system and interconnection between DC-DR in the project areas has to be completed by the SI as mentioned in RFP or as per the contract roll out plan. Any delay in the construction of all civil works, data centre hardware and software, elevator, DG, transformer and other power supply system, security system, FFT, cooling system etc. and their roll-out will attract penalty for every month of delay subjected to maximum penalty of 10%. It will be levied for the duration equivalent to number of weeks (months) delayed which shall be deducted from subsequent months based on the milestone payments.

In case, the system integrator is unable to implement the any part of the scope of work within the given timelines and project implementation duration is extended beyond the period of 1.5 years. In such case, the NEA reserves the full authority to get the remaining part of project work completed from other agencies at the cost proposed by the SI.

4.2 Availability DC-DR communication system

Availability would be calculated on monthly basis. The formula to be used for availability computation would be as under:

Availability pe

Monthly (per site) = THM- (S1 x 1+S2 x0.4+S3 x 0.1) x 100%

THM

Where THM is total hours in the month

S1 is the total non-available hours in Severity Level 1

S2 is the total non-available hours in Severity Level 2

S3 is the total non-available hours in Severity Level -3

Payment of maintenance charges (based on communication system availability)

In the event of availability below a certain level, the maintenance charges would be proportionately reduced as follows:

DWDM Infrastructure SLA



Service Levels for Cloud Platform Provider						
Sl. No.	**Service**	**Parameter**	**Service Level**	**Measurement Tool /Validation**	**Penalty**	
1	Requirement of Virtual Machines / Computer	Provision and Deprovision of virtual machines	Within 15 minutes	Report	Within 15 minutes	No Penalty
					>15 but <=45 Minutes	1% of the Quarterly Payment
					Beyond 45 minutes, for every 30 minutes of delay	3% of the Quarterly Payment
2	Overall Cloud Solution availability	Availability of Cloud Solution Services and Supporting Solutions	>=99.95 % uptime	Availability & Downtime Reports, measured using Management Tool. Measured 24*7 Basis and Validated by Quarterly SLA Performance Report.	Less than 0.05% of SLA	No Penalty
					>= 0.05% but <0.1% of SLA	1% of the Quarterly Payment
					>= 0.1% but <0.3% of SLA	3% of the Quarterly Payment
					>= 0.3% but <0.5% of SLA	5% of the Quarterly Payment
					>=0.5% of SLA	10% of the Quarterly Payment
3	Cloud Virtualization Layer Availability	Cloud Virtualization Layer Availability for Hosted Solution &Services	>=99.95 % uptime	Availability & Downtime Reports, measured using Management Tool. Measured 24*7 Basis and Validated by Quarterly SLA Performance Report.	Less than 0.05% of SLA	No Penalty
					>= 0.05% but <0.1% of SLA	1% of the Quarterly Payment
					>= 0.1% but <0.3% of SLA	3% of the Quarterly Payment
					>= 0.3% but <0.5% of SLA	5% of the Quarterly Payment
					>=0.5% of SLA	10% of the Quarterly Payment
4	Cloud Network Availability	Cloud Network Availability for Hosted	>=99.95 % uptime	Availability & Downtime Reports, measured using	Less than 0.05% of SLA	No Penalty
					>= 0.05% but <0.1% of SLA	1% of the Quarterly Payment

		Solution & Services		Management Tool. Measured 24*7 Basis and Validated by Quarterly SLA Performance Report.	>= 0.1% but <0.3% of SLA	3% of the Quarterly Payment
					>= 0.3% but <0.5% of SLA	5% of the Quarterly Payment
					>=0.5% of SLA	10% of the Quarterly Payment
5	Cloud Storage Availability	Cloud Storage Services Availability for Hosted Solution & Services	>=99.95 % uptime	Availability & Downtime Reports, measured using Management Tool. Measured 24*7 Basis and Validated by Quarterly SLA Performance Report.	Less than 0.05% of SLA	No Penalty
					>= 0.05% but <0.1% of SLA	1% of the Quarterly Payment
					>= 0.1% but <0.3% of SLA	3% of the Quarterly Payment
					>= 0.3% but <0.5% of SLA	5% of the Quarterly Payment
					>=0.5% of SLA	10% of the Quarterly Payment
6	Cloud Orchestration layer availability	Cloud Orchestration layer availability for Hosted Solution & Services	>=99.95 % uptime	Availability & Downtime Reports, measured using Management Tool. Measured 24*7 Basis and Validated by Quarterly SLA Performance Report.	Less than 0.05% of SLA	No Penalty
					>= 0.05% but <0.1% of SLA	1% of the Quarterly Payment
					>= 0.1% but <0.3% of SLA	3% of the Quarterly Payment
					>= 0.3% but <0.5% of SLA	5% of the Quarterly Payment
					>=0.5% of SLA	10% of the Quarterly Payment
7	Cloud Security Layer Availability	Cloud Security layer availability for Hosted Solution & Services	>=99.95 % uptime	Availability & Downtime Reports, measured using Management Tool. Measured 24*7 Basis and Validated by Quarterly SLA Performance Report.	Less than 0.05% of SLA	No Penalty
					>= 0.05% but <0.1% of SLA	1% of the Quarterly Payment
					>= 0.1% but <0.3% of SLA	3% of the Quarterly Payment
					>= 0.3% but <0.5% of SLA	5% of the Quarterly Payment
					>=0.5% of SLA	10% of the Quarterly Payment

Sl. No.	Service	Parameter	Service Level	Measurement Tool /Validation	Penalty	
1	DWDM Equipment's availability	Availability of DWDM equipment's for Supporting DRC services	>=99.95 % uptime	Availability & Downtime Reports, measured using Management Tool. Measured 24*7 Basis and Validated by Quarterly SLA Performance Report.	Less than 0.05% of SLA	No Penalty
					>= 0.05% but <0.1% of SLA	1% of the Quarterly Payment
					>= 0.1% but <0.3% of SLA	3% of the Quarterly Payment
					>= 0.3% but <0.5% of SLA	5% of the Quarterly Payment
					>=0.5% of SLA	10% of the Quarterly Payment
2	Link between DR & DC	One OFC out of two must be up and running all the time	=100 % uptime	Availability & Downtime Reports, measured using Management Tool. Measured 24*7 Basis and Validated by Quarterly SLA Performance Report.	Less than 0.05% of SLA	1% of the Quarterly Payment
					>= 0.05% but <0.1% of SLA	3% of the Quarterly Payment
					>= 0.1% but <0.3% of SLA	5% of the Quarterly Payment
					>= 0.3% but <0.5% of SLA	8% of the Quarterly Payment
					>=0.5% of SLA	10% of the Quarterly Payment
3	Optical Fibre connectivity b/w DC-DR each link	Availability of Optical Fibre connectivity b/w DC-DR each link or Hosted Solution & Services	>=99.8 % uptime	Availability & Downtime Reports, measured using Management Tool. Measured 24*7 Basis and Validated by Quarterly SLA Performance Report.	Less than 0.05% of SLA	No Penalty
					>= 0.05% but <0.1% of SLA	1% of the Quarterly Payment
					>= 0.1% but <0.3% of SLA	3% of the Quarterly Payment
					>= 0.3% but <0.5% of SLA	5% of the Quarterly Payment
					>=0.5% of SLA	10% of the Quarterly Payment

In case of a disaster strike at primary data centre, the SI will arrange to provide the services in an undisturbed manner. Following RPO and RTO will be desirable-

RPO & RTO Recovery Point Objective (RPO) is the maximum amount of time lag between Primary and Secondary storages. NEA intends to maintain RPO as < 15 Seconds for all application and data at primary site.

Recovery Time Objective (RTO) is maximum elapsed time allowed to complete recovery of application processing at DR site. In case of a disaster, the RTO shall be measured from the time when the decision is finalized & intimated to the System Integrator (SI) by NEA to shift the operation to DR site. The System Integrator (SI) in association with NEA personnel shall ensure compliance to following RTOs –

Sl. No.	Service	Parameter	Service Level	Measurement Tool /Validation	Penalty
1	Recovery Time Objective (RTO) (Applicable when taking Disaster Recovery)	Measured during the regular planned or unplanned (outage) changeover from DC to DR or vice versa.	RTO <5 minutes	Quarterly Report	5% of Quarterly Payment per every additional 5 minutes delay of data lag.
2	Recovery Point Objective (RPO) (Applicable when taking Disaster Recovery)	Measured during the regular planned or unplanned (outage) changeover from DC to DR or vice versa.	RPO <15 second	Quarterly Report	5% of Quarterly Payment per every additional 5 Sec lag.

For individual hardware & non- critical functions

Availability per quarter	**Deduction as % of the apportioned price of total FMS for DC-DR communication portion of the contract applicable for that site**
>98%	NIL
Less than 98%	Deduction of 2% of the apportioned price of the apportioned quarterly FMS

While calculating availability following shall be considered:

a) The overall DC-DR system shall be considered as available if.

1. DC-DR connection are available
2. NMS applications are available
3. Redundant path connection is available without degradation in the response times
4. Network testing Information transfer between DC and DR end points are available

Further, non-availability of power supply system because of utility and fibre damaged in HT line shall not be considered for calculating overall system availability.
However, each DWDM device exhibit a minimum availability of 99.5% and amplifiers shall individually exhibit a minimum availability of 98%.
The computation of availability / non-availability would be rounded up to 2 decimal places at each contract co-ordination site on monthly basis and any deduction in the maintenance charges thereof would be calculated as stated above on pro-rata basis.

4.3 Operation Service Levels for DRC area and other area

Operations after the handover is one of the most critical activities the successful bidder must perform in the facility. Multi skilled manpower are required to operate the Disaster Recovery Centre (DRC) These SLAs shall be strictly imposed for the target performance metrics as outlined in the table below.

S. N.	Measurement **parameter**	**Target**	**Severity**	**Penalty applicable on monthly FMS charges payable towards DRC maintenance**
1.	**Power availability:** (Transformer, RMU, DG, UPS & battery backup system etc.)	>= 99.749%	Critical	No penalty
		<99.749% to >= 99.5%		1 % of monthly bill
		>=98% to <99%		2 % of monthly bill
		>=95% to <98%		3 % of monthly bill
		<95%		5% of monthly bill
2	**PAC system availability including redundant units.** maintained 21°± 2° at all times relative humidity to be maintained 50°± 5° at all times.	>= 99.749%	Critical	No penalty
		<99.749% to >= 99 %		1 % of monthly bill
		>=98% to <99%		2 % of monthly bill
		>=95% to <98%		3 % of monthly bill
		<95%		5% of monthly bill
3	**Surveillance:** CCTV availability would include storage system availability, availability of CCTV recording.	>= 99.749%	Critical	No penalty
		<99.749% to >= 99 %		1 % of monthly bill
		>=98% to <99%		2 % of monthly bill
		>=95% to <98%		3 % of monthly bill
		<95%		5% of monthly bill
4	**Complete BMS system:** This parameter applies to any individual components of BMS system, i.e., VESDA, fire detection, fire suppression, water leak detection, rodent repellent etc. For any component downtime, the penalty will be applicable.	>= 99.749%	Critical	No penalty
		<99.749% to >= 99 %		1 % of monthly bill
		>=98% to <99%		2 % of monthly bill
		>=95% to <98%		3 % of monthly bill
		<95%		5% of monthly bill

S. N.	Measurement **parameter**	**Target**	**Severity**	**Penalty applicable on monthly FMS charges payable towards DRC maintenance**
5	**Manpower Availability:** Expert manpower shall be available 24/7 on call and shall be available at site within 30 minutes after problem occurs. Support personals shall be hired locally in DR site.	99%	Critical	5% of monthly bill
6	**Helpdesk Availability:** Helpdesk system shall be fully automated and send information through mobile SMS and email and immediate actions shall be taken by resolution team just after information provided. Response time shall not be more than 15 minutes time to resolution shall not exceed 120 minutes.	99%	Critical	5% of monthly bill

5. Annexures

5.1 Annexure – 1:

The contractor shall provide a LED Display based on the specification specified below. The Display system will be used to project displays of NOC and BMS system independently of workstation console monitors.

5.1.1 NOC Room UHD (3840 x 2160) LED Display minimum technical specification:

It shall be the responsibility of contractor to supply the complete package. Any additional device and software if required for content management to support tile display also needs to be included.

Minimum Technical Specification for Display			
Panel	Diagonal Size		Minimum 75 inch
	Type		LED
	Resolution		UHD (3840 x 2160)
	Pixel Pitch (mm)		0.4875 x 0.4875
	Brightness (Typ.)		500 Nits
	Contrast Ratio (Typ.)		4000:01:00
	Viewing Angle(H/V)		178/178
	Display Colours		16 M (True Display)
	Operation Hour		24 x 7 x 365
Connectivity	INPUT	RGB	DVI-D, Display Port
		VIDEO	HDMI
		USB	USB 2.0 x 2
	OUTPUT	RGB	HDMI 2.0 (Loop-out)
Power	Type		Internal
	Power Supply		AC100 - 240 V, 50/60 Hz
Mounting	Stand Type		Wall Mount
Operation	Operating Temperature		0℃~ 45℃
	Humidity		10~80%
Certification	Safety		60950-1 Safety-certified display or Compliant with industry safety standards
	EMC		Class A
	Security		Supports enterprise-grade wireless security protocols
Accessories	Mandatory		Quick Setup Guide, Warranty Card, Power Cord, Remote Controller, Batteries

5.1.2 BMS Room UHD (3840 x 2160) LED Display minimum technical specification:

It shall be the responsibility of contractor to supply the complete package. Any additional device and software if required for content management to support tile display also needs to be included.

Minimum Technical Specification for Display			
Panel	Diagonal Size		Minimum 75 inch
	Type		LED
	Resolution		UHD (3840 x 2160)
	Pixel Pitch (mm)		0.4875 x 0.4875
	Brightness (Typ.)		500 Nits
	Contrast Ratio (Typ.)		4000:01:00
	Viewing Angle(H/V)		178/178
	Display Colours		16 M (True Display)
	Operation Hour		24 x 7 x 365
Connectivity	INPUT	RGB	DVI-D, Display Port
		VIDEO	HDMI
		USB	USB 2.0 x 2
	OUTPUT	RGB	HDMI 2.0 (Loop-out)
Power	Type		Internal
	Power Supply		AC100 - 240 V, 50/60 Hz
Mounting	Stand Type		Wall Mount
Operation	Operating Temperature		0℃~ 45℃
	Humidity		10~80%
Certification	Safety		60950-1 Safety-certified display or Compliant with industry safety standards
	EMC		Class A
	Security		Supports enterprise-grade wireless security protocols
Accessories	Mandatory		Quick Setup Guide, Warranty Card, Power Cord, Remote Controller, Batteries

5.2 Annexure – 2: Disaster recovery centre facility

Scope of work for the system integrator under this project would be as follows: The DRC facility project is divided into below phases:

1. Initiation
2. Design
3. Procure & Supply (Including Factory Acceptance test)
4. Implementation
5. Operational Acceptance

Procure and supply: The bidder should procure the material as per the schedule from reputed manufacturer/as per the list of makes agreed through bidding process only. The same should be supplied after factory acceptance test, when the work demands during the execution.

Implementation: The implementation would be a continuous process in this project. The bidder should engage skilled manpower for the implementation. The implementation should be done as per the standards and best practices as agreed by the bidder. Any deviation would result in rework till the perfection is achieved and cost incurred due the rework and delay would be borne by the bidder.

General requirement

The disaster recovery centre is the foundation for IT systems of NEA; to provide the basic power, cooling and racks system for the IT infrastructure the disaster recovery centre should meet the uptime tier III design and TIA942-B, and the bidder should meet:

Basic technical requirements are as follows:

- Total 60 racks (54 IT racks and 6 network racks) each IT racks power design for 10kW, network rack 7 kW;
- 2N power supply system, modular UPS with hot-swappable power module.
- Backup time minimum 15 minutes for battery at full load.
- Containment for modular disaster recovery centre, hot and cold aisle containment separated hot & cold air in data hall to improve cooling efficiency. In-room cooling air conditioner with N+1 redundancy.

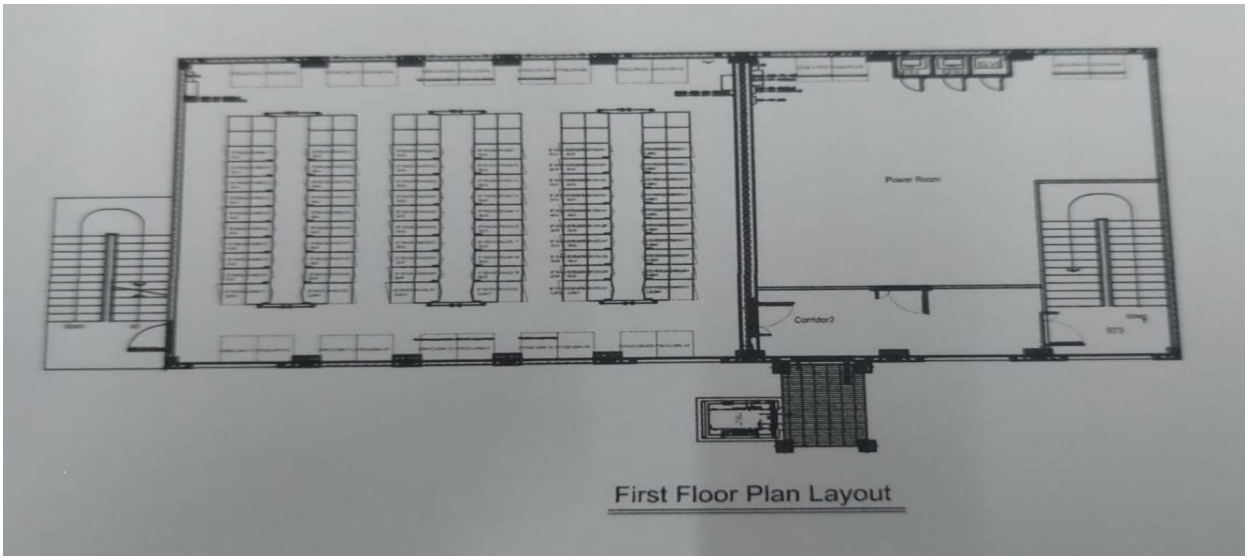


Figure 5: Disaster recovery centre layout (illustrative only)

Electrical System

1) Detail site survey shall be done by the selected bidder for the existing electrical installation.
2) Supply and installation of two different feeder supply A & B for disaster recovery Centre, including required number of RMU and transformer as per approved design to comply tier III standard.
3) Supply and installation of 2 numbers of diesel generators and creating exhaust stack as required by the site authorities to meet tier III standard.
4) Supply and installation of suitable modular UPS system along with batteries.
5) Supply of double electrical main panel for each side of the source.
6) Supplying and laying of cable to the DC power room though trench, ladder and cable trays as suitable as per the site conditions from the main power supply source is responsibility of the selected bidder.
7) Supply and installation of all other panels and DBs for ACs, lighting and raw power.
8) Supply and installation of proper cabling and wiring for the entire site as per the design requirements.
9) Supply and installation of proper earthing and grounding at the site and connecting the same to each of the equipment.
10) Supply and installation of LED lighting for the entire area.

11) Supply and installation of switches, SOCKETs, wall outlets, industrial SOCKETs, IEC connectors etc.
12) Supplying electrical safety items.
13) Supply and installation of termination of cables and wires.
14) Testing of all the items at site.
15) Thermal imaging of the terminations with load.
16) Power quality check with class A measuring tools during SAT.
17) All other required accessories to complete the above-mentioned electrical system.

HVAC system

1) Direct Expansion based In- room cooling system is for IT racks in data hall.
2) Direct Expansion based in-room cooling system is for power room.
3) Refrigerant pipes, pipe for dehumidifier water should be considered.
4) Containment housing with sliding doors on both sides of the aisle.
5) Providing linear grills and diffusers in the non-technical area.

Rack and containment system

1) Total 60 racks (54 IT racks and 6 network racks).
2) Hot aisle at rear and cold aisle at front of the racks.
3) Hot aisle containment with skylights and accessories.
4) Sliding doors and access control for containment.
5) Rack PDU.

Safety Security, Surveillance and Monitoring

Safety and security system: design, supply, installation, testing and commissioning of security systems comprising the following components:

1) Fire alarm system.
2) Public address system.
3) High sensitivity smoke detection system.
4) Gas based fire suppression system.
5) Access control system.
6) CCTV surveillance system.
7) Water leakage detection system.
8) Rodent repellent system.
9) Intelligent building management system.
10) The fire detections system has to-be integrated by building fire detection system.
11) Bird repellent system.

Other Items

1) Generator system.
2) 42U racks with intelligent PDUs and rack access control.
3) Passive network cabling as per TIA latest standard.
4) Periodic health audit and preventive maintenance of the infrastructure.
5) Uptime tier III Compliant.

Power system

The 2N power distribution architecture is used.

UPS

- The UPS should be modular and having integrated design. UPS configuration is 2N redundancy. The lithium battery provides 15 minutes system backup time.
- Module design for UPS, each power module not less than 50KVA, the efficiency of UPS no less than 96%. The power requirement shall be supported by the calculations.
- The modular UPS system shall use concentrated bypass, and the bypass module shall be hot swappable. A built-in bypass shall be provided.
- The system shall support self-load function to debug easily.
- The system can detect bus capacitor rest running life and give alarms before the capacitor failure.
- At online mode, the system efficiency of UPS should be 96% at half rated load. At ECO mode, the operating efficiency shall be no less than 99%.
- One of the power module fan failures, the power should not quit running, the power module still can take 50% load.

5.3.7 Precision air conditioner system

The PAC system consists of the cooling system, water supply and drainage.

- The cooling system mainly refers to the cooling system in the equipment area and power supply and distribution area.
- The fresh air system supplies fresh air to each area. The fresh air system uses the fresh air processor and air pipes. Air dampers are used to separate protected areas. The fresh air system is used to maintain the positive pressure and provide fresh air for the main equipment room. If there is a certain pressure difference between indoor and outdoor, the air supply and exhaust need to be balanced.
- Water supply and drainage mainly include humidification and water supply, condensate drainage, water supply and drainage for fire extinguishing systems, and living water supply and drainage. Water supply pipes can share the main pipe with humidifier water inlet pipes in the equipment room, and an independent drainage system is required for drainage pipes.

- The A/C should have a minimum cooling capacity of complete DRC load on the following condition: return air dry bulb temperature 35℃, relative humidity 26%, and outdoor temperature 35℃.
- Support dehumidifier function at 10% load or above.
- The cooling system adapts air-cooled in-room A/C, N+2 redundancy for data Centre and N+1 redundancy for power room.
- A/C is equipped with high efficiency variable frequency compressor.

5.3.8 Rack and containment system

Containment type

A contained cold or hot aisle consists of front & end doors and cabinets. The aisle containment adopts the cameras, temperature and humidity (T/H) sensors, smoke detectors.

Sealing skylights

- Sealing skylights are mainly used for modular aisle sealing.
- The skylights should use toughened glass, of which the area is greater than or equal to 75%. The thickness should ≥5 mm. The materials should meet the requirements of fire prevention in the machine room.
- When receiving a fire alarm signal, the skylight controller opens the skylight by controlling the electromagnetic lock, sends out an audible and visual alarm signal at the same time, and uploads the alarm signal to the equipment room management system.

Aisle containment dimension

Minimum width: 1200mm; Minimum height: 2000mm

(Vendor has to submit the design specifications for approval)

Rack

Standard 19-inch rack for 42 U, dimension:600*1200*2000 mm for IT rack, 600 / 800 *1200*2000mm for network rack; ventilation rate of front and rear door no less than 70%, static load no less than 1500 kg; with monitor rack PDU for each rack.

5.3.9 Lighting system

An intelligent lighting system is installed in the disaster recovery centre, office area, corridor aisle, and staircase and other areas. The lights shall be controlled through intelligent motion sensors and turn off / on when there is no occupancy / when there are people.

Lights are controlled by the switch on the panel without intelligent lighting in other areas, such as the power room, medium-voltage room. Other detail shall be provided by the bidders.

5.3.10 Fire extinguishing system

The contractor shall be responsible for the detailed design, supply, and installation and commissioning of all of the fire alarm systems for the new disaster recovery centre facility.

That shall include the supply and installation of all necessary accessories like detectors, sounders, flashing beacons, break glass units, cabling and containment within the space.

The system installation shall be carried out in conjunction with an approved fire alarm supplier.

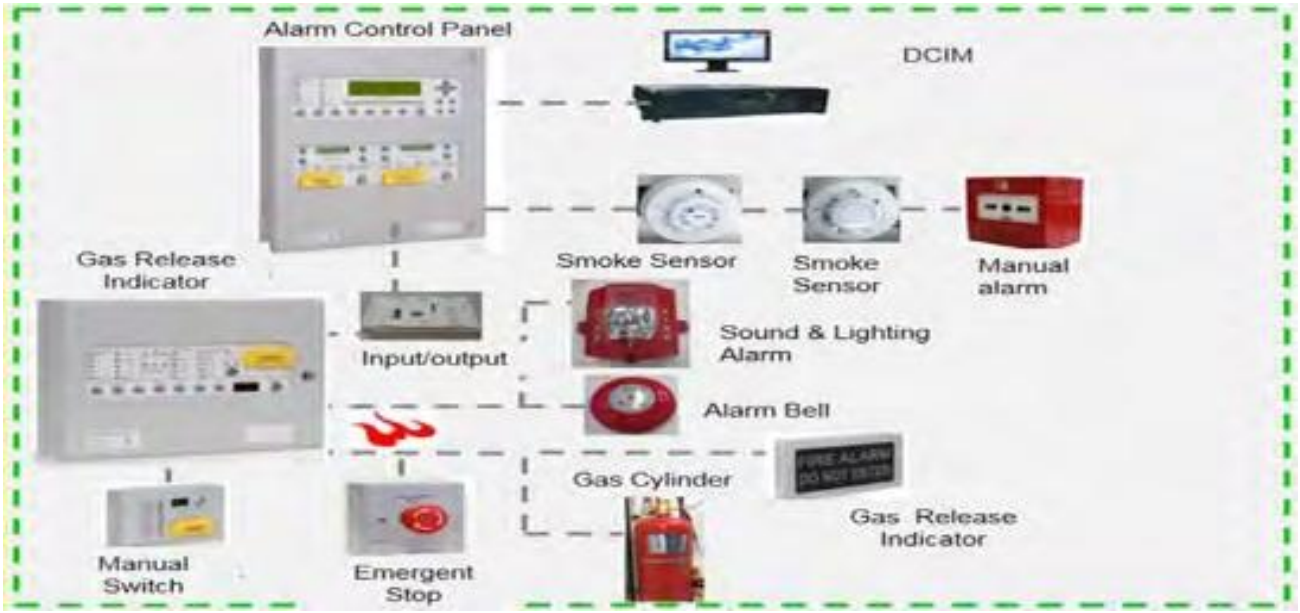
The fire extinguishing system consists of the automatic fire alarm system, automatic gas extinguishing system, emergency lighting and evacuation system, automatic water sprinkler system, hand-held fire extinguisher, fire hydrant, fire pump, and water tank.

SN	Technical specifications/requirements	Compliance YES/NO
	Fire extinguishing system	
1	The system required is for continuous (fail-safe) surveillance against any fire incidence in various areas. Accordingly, the system should have the following proven TECHNOLOGICAL, TECHNICAL AND OPERATIONAL FEATURES:	
2	The system should be continuously available (fail-safe) and therefore the system should have microprocessor based dual processor CPU and dual electronics in other modules like relays, loop card, etc. i.e., 100% hot redundancy circuitry.	
3	The system should have features to avoid false alarms. To have this feature incorporated, the system should have programmable sensing levels of detectors, adjustable/adaptable against the change in environment (dust level, temperatures etc.)	
4	Zones/individuals detectors in the same loop shall be able to be set at different sensing levels and shall be possible to be changed through programming at any time.	
5	The system should have exact identification of location and nature/ type of fire incidence/ circuit fault/ emergency (the manual call point) to enable quick response to the incidence (fire or fault). Therefore, the system components (detectors, MCP's etc.) shall be self-managing type and should have inbuilt microprocessors for this purpose.	

6	The system should CONTINUE TO BE ACTIVE against any fault / fire incidence at any device; the device/detector should only isolate itself so that the balance circuit/surveillance remains available. Therefore, the system components (detector, MCP, sounder, duct detector etc.) should have built-in short-circuit isolator.	
7	Being an emergency system, to allow for enough time to set right the system against any power failure, the system should have maximum possible duration of battery backup power supply.	
8	Hence as per EN standard specifications, the backup battery power should be for 72 hours at least. The batteries should be housed inside the FACP.	
9	Modular addition facility shall be available in the fire alarm panel for future additions of loops and devices.	
10	The offered system should have “interfacing capability” with any conventional system (existing or new) so that the fire incidence surveillance is extended to areas covered / to be covered by such conventional systems.	
11	The devices shall be max loop- powered to reduce the cabling. (This shall be a point for evaluation / loading of the total cost of installation.)	
	The system shall be possible to be monitored from single PC station, if desired, making the fire surveillances visually available if and wherever desired later.	

The fire extinguishing system in the in-room scenario uses an addressable system. Fire control panel is installed for the security of the entire disaster recovery Centre building. The addressable smoke detector, temperature sensor, dual action addressable manual pull station, and input and output modules shall use the two-bus system and are all connected to the fire control panel to monitor alarms and fault status. The fire control panel is connected to the DCIM over TCP/IP to upload fire alarms and fault signals. The fire extinguishing components in the protected area, such as the fire alarm bell, horn strobe, extinguishing abort button, warning signs, manual/automatic switches, start-up controller, pneumatic switch, and electrical actuator are all connected to the control panel for fire control and management.

Architecture of the addressable fire extinguishing system



Note: The figures provided above are for reference and bidding purpose only. The bidder shall include the technical features of their product with the bid.

System Operation Modes

The fire extinguishing system of the prefabricated data centre shall have smoke detector and heat detector that use the double-loop alarm and control method. The fire extinguishing system shall support automatic and manual operation modes and has the emergency start/abort switch used to manually operate the system in the case of emergencies.

5.3.11 Gas Suppression System

General

The Contractor shall design, supply, install, test and commission all necessary fire alarm system to be installed within all areas of the facility.

The system shall comply with the following standards and codes：

- Fire and Life Safety code of practice
- NFPA 72, 75, 76 and NFPA 101

SN	Technical specifications/requirements	Compliance YES/NO
	System action process	
Gas suppression system		
1.	The available electrical power is 220 VAC (±10%) and 50 Hz (±3%).	
SN	**Technical specifications/requirements**	Compliance YES/NO
2.	**Uninterrupted Power Supply (UPS):** The FAS shall operate on internally placed and fully captive 24 VDC (nominal) SMF batteries with inbuilt charger for a minimum of 72 hours in normal conditions and 120 minutes in alarm condition in case of failure of mains power.	
3.	All system components like detectors, manual call points, sounders shall have corrosion resistant contact points. Termination of SLC cable at devices & panel shall be properly sealed to avoid false alarms due to spurious signal pick up. Recessing & dressing of cabling work inside & outside of building on wall & ceiling shall be done neatly to maintain good aesthetic view.	
4.	The entire FAS shall be intelligent digital addressable type. The system components shall have soft addressing.	
5.	The FAS shall operate on 2 wires (or a 2-core cable) with single loop.	
6.	The multi-criteria detectors shall have an electronics free common base of 4” (100 mm) nominal diameter.	
7.	The multi-criteria detectors and manual call points shall have inbuilt fault isolators.	
8.	The multi-criteria detectors shall have a plug-in wiring connector for ease of installation and serviceability. Easy wiring using terminal block shall be provided to enable removal of a detector without loss of power to the remaining loop.	
9.	The multi-criteria detectors shall have an inbuilt function test switch, which initiates local visual alarm signal through LED but neither the fire alarm is enunciated nor any actions initiated on this signal. OR Panel should have “maintenance” mode to test for alarm signal, where output is not activated.	
10.	Once set; the sensitivity should remain fixed; irrespective of the variation of environmental factors like temperature, humidity, dust level etc. No drift in the sensitivity should be allowed for a fixed environmental condition.	

11.	The detectors should have a facility of automatic drift compensation, and they should adjust to the environmental changes.		
12.	All the components and devices of FAS of the Fire Alarm Control Panel (FACP) should work on power drawn from FACP. External powering should allow in case of supply of sounder cum strobe.		
13.	Any addressable device in the system may be enabled or disabled through the system keypad.		
SN	**Technical features**		**Compliance YES/NO**
14.	A system status report will be generated and printed by the system operator's command.		
15.	The environmental conditions are 10%-95% RH and 0-40°C ambient temperature.		
16.	The fire alarm control panel shall be compatible with RS 485.		
17.	Intelligent feature	Dual CPU	
18.	Inbuilt redundancy	100%hot redundancy: Double circuits such as redundant CPU and redundant loop card leading to failsafe operation.	
19.	Number of loops	1 loop expandable to 10 loops	
20.	Capacity	250 detectors & devices per loop	
21.	Sensitivity adjustment	Adjustable from FACP or PC	
22.	Maintenance	Missing & contamination alerts	
23.	Authentication	Two level password protection	
24.	No of users	3 user level passwords	
25.	Programmability	Through panel and through PC	
26.	Display	5.7" TFT colour plain text display	
27.	Sounder	Inbuilt, different tones for fire & fault	

28.	Event logging	1000 events	
29.	Messaging	Automatic SMS to 5 mobile numbers	
30.	Dialling	Automatic dialling to 3 telephone numbers for giving pre-recorded messages of 60 seconds duration. Prerecording on non-volatile memory.	
SN	**Technical features**		**Compliance YES/NO**
31.	Construction	Polycarbonate plastic	
32.	Output	Local and FACP	
33.	Maintainability	Build-up of dirt or similar contamination on the sensing chamber shall be continually monitored by control panel, when it exceeds predetermined level; the panel should indicate that the detector needs servicing. The type of fault should be available on the computer or on the panel. The detector sensing chamber shall be easily removable for cleaning and maintenance purpose.	
Technical specification of sounder			**Compliance YES/NO**
1.	Sound level	90 dB (A)	
2.	Function test	Possible from FACP	
3.	Strobe light	High intensity light from LED	
4.	Tone adjustability	Yes	
5.	Powering	By FACP	
6.	Intelligent feature	Integral microprocessor	
7.	Type	Press glass, double action	
8.	Cover	Transparent protective flip cover in unbreakable type polycarbonate.	

9.	Reset	Directly from panel	
10.	Colour	Red	
11.	Powering	By FACP	
	Parameter	**Repeater panel**	**Compliance YES/NO**
	Display	5.7" TFT colour plain text display	
Technical specification of MCP			**Compliance YES/NO**
1.	Network	Networkable with another repeater panel and fire alarm panel	
2.	Enclosure	As per manufacturer	
3.	Navigation	Scroll wheel OR arrows buttons	
4.	Powering	Through FACP-UPS	
	Parameter	**Technical specification of computer**	**Compliance YES/NO**
1.	Type	Industrial PC	
2.	Processor	Intel 4th generation core i5	
3.	Operating system	Latest windows professional version	
4.	Memory	16 GB	
5.	Hard drives	1TB SATA HDD with one hot spare HDD with auto rebuild.	
6.	Graphics	HD graphics card	
7.	Connectivity	RS 485, USB, HDMI out, LAN	
8.	Monitor	24” LED monitor	
	Parameter	**Technical specification of cable**	**Compliance YES/NO**

1.	Category	FRLS	
2.	Conductor material	Copper	
Aspiration smoke detection system			
SN	**Technical specifications/requirements**		**Compliance YES/NO**
1.	An aspirating smoke detector should be offered which continuously takes air samples via a pipe network from a monitored space and feeds the samples to one or more smoke detectors. Airflow monitoring ensures that the sensor tube is continuously monitored for pipe breakage and sampling hole soiling.		
2.	Difficult to access areas such as intermediate ceilings, false floors, high bay storage.		
3.	In listed buildings or in aesthetically demanding interiors where point detectors on the ceiling would disturb the interior design. In areas where high sensitivity is required, e.g., disaster recovery centres, server cabinets.		
4.	If filters are used, dirty areas can also be monitored. Monitoring large ventilation ducts compliant with EN 54-27.		
	The display functions to include:		
	Operation		
	Fault		
	Pipe breakage		
	Pipe blockage		
	Smoke sensor		
	Dust/soiling		
	Pre-signal 1, 2 and 3		
	Alarm		
	Alarm 2		
	10-level smoke level indicator		
	The control functions include:		

1.	Power ON/OFF	
2.	State display	
Gas suppression system		
SN	**Technical specifications/requirements**	**Compliance YES/NO**
	Intent of specifications	
	This specification is for procurement of total flooding fire suppression system, designed for use with clean agent. All requirements outlined in this specification must be completed in their entirety. Gas used: FK-5-1-12 or equivalent NOTE: All gases to be used shall be environment friendly, and the bidder is required to provide the document proof during drawing approval.	
	General description	
1.	Fire suppression systems shall be used to suppress fires in specific hazards or equipment located where an electrically non-conductive agent is required, where agent clean-up creates a problem, where extinguishing capability with low weight is a factor and where personnel normally occupy the hazard.	
2.	Fire suppression systems shall be designed for the following classes of fire:	
3.	Class A: Surface type fires—wood or another cellulose-type material	
4.	Class B: Flammable liquids	
5.	Class C: Energized electrical equipment	
6.	For hazards beyond the scope described above, the designer shall consult with OEM and NFPA 2001.	
	CODES AND COMPLIANCE	
1.	The design, installation, testing and maintenance of the fire suppression systems, employing FK-5-1-12, shall be in accordance with the following codes, standards and regulatory bodies:	
2.	NFPA 2001: *Standard for Clean Agent Fire Extinguishing Systems.*	
3.	UL 2166: *Standard for Halocarbon Clean Agent Extinguishing System* Units or any international equivalent.	

4.	IS: 14520: *Gaseous Fire Extinguishing System - General Requirements*	
5.	IS: 14520: Inspection and Maintenance of Gaseous Fire Extinguishing System - Code of Practice	
6.	ANSI B1.20.1: *Standard for pipe threads, General Purpose, 1992*	
SN	**Technical specifications/requirements**	**Compliance YES/NO**
1.	NFPA 70 - NEC – *National Electrical Code*	
2.	NFPA 72 – *National Fire Alarm Code*	
3.	Requirements of the local authorities having jurisdiction (AHJ)	
4.	The manufacturer shall meet ISO 9001 requirements for the design, production and distribution of the engineered fire suppression system.	
5.	All components of the total flooding suppression system shall be the products of the same manufacturer or listed by that manufacturer as compatible with those devices, components and equipment.	
	System design criteria	
1.	The designer shall consider and address possible fire hazards within the protected volume at the bid stage. The delivery of the gas system shall provide for the highest degree of protection and minimum extinguishing time. The design shall be as per NFPA 2001.	
2.	Sub floor and the ceiling void to be included in the protected volume. Server farm, UPS room and battery room must be covered under the gas flooding system with single / multiple systems	
3.	The discharge time required to achieve 95% of the minimum design concentration for flame extinguishment shall not exceed ten (10) seconds. In accordance with NFPA Standard 2001.	
	Engineered design drawings	
1.	The OEM-authorized Distributor or OEM shall provide all required installation drawings per NFPA 2001.	
2.	Flow calculation reports	

3.	The system flow calculations shall be carried out on certified software, suitable for the seamless cylinder container being offered for this project. Such System flow calculations carried out for this project shall be further vetted by the OEM for its accuracy, and the only such vetted calculations shall be admissible for approval by the consultant.	
	System hardware	
	Fire suppression systems shall include the following components:	
SN	**Technical specifications/requirements**	**Compliance YES/NO**
1.	Pipe and pipe fittings; distribution piping, and fittings, shall be installed in accordance with NFPA 2001, approved piping standards and the engineered fire suppression system manufacturer's requirements.	
2.	Pipe: As per ASTM A-106, Sch 40, M. S. seamless	
3.	Actuation hardware: The clean agent cylinder valve assembly shall be actuated using an electric control head (solenoid) the actuator should have facility of manual actuation also.	
4.	Distribution nozzles: discharge nozzles shall be used to disperse the clean agent.	
5.	Seamless cylinders and valve assemble: The gas shall be stored in seamless type Cylinders. Welded cylinders are not permitted. Agent cylinder operating pressure shall be at 360 PSIG @ 70°F (24.8 bar gauge @ 21°C). Offer Cylinder shall be manufactured and tested in accordance with ISO 9809-1 Standard. Clean Agent storage cylinders shall be equipped with safety rupture disc and pressure gauge to display internal pressures. The gauge shall be an integral part of the equipment and shall be color-coded for fast referencing of pressure readings	
6.	Pressure control operated head: Pressure operated control head, should allow for pressure actuation of clean agent storage cylinders.	
7.	**Flexible discharge hose &actuation hose**	
8.	The flexible actuation hose should be usually used in multiple cylinder systems.	
Access control system		

SN	Technical specifications/requirements	Compliance YES/NO
1.	Access to the facility must be though 2 levels of authentication. First level at the reception of the disaster recovery centre entry through access card and second level at the disaster recovery centre entry door through biometric and pin pad/ contact less card access.	
2.	The Integrated Access Control System's (ACS) primary function shall be to regulate access through specific doors, gates or barriers to secured areas of the facility. It shall also have the provision of capturing cardholder images and producing access cards used to provide this access	
SN	**Technical specifications/requirements**	**Compliance YES/NO**
3.	An Intelligent System Controller (ISC) shall link the ACS software to all other field hardware. It shall provide full distributed processing for access control and alarm monitoring operations. Controller should be 8 doors, 40,000 cards capacity, and 10000 events. Interface on RS232, RS485 and TCP/IP	
4.	A Dual Reader Interface Module (DRIM) shall be available for each controlled door and provide the ability to connect to two card readers or entry devices.	
5.	Smart card readers at every critical door for entry and exit. Biometric fingerprint card reader for critical door of server room door only for entry point and exit smart card readers.	
6.	Enterprise version server software for access control & time and attendance with capability to service minimum 1 concurrent clients, inclusive of one server &one client license. Shall be capable to communicate with centralized command software.	
7.	Biometric + smart card readers, shall have 2" IPS (In Plane Switching) touch screen LCD with corning glass scratchproof protective glass with smart card reader module. Authentication shall be done in 1 second and the 1GB memory on board for user storage of minimum 500 users with a card & 5000 events transaction log capability.	
8.	All doors will have access control through pin pad and contact less readers.	
CCTV System		

SN	Technical specifications/requirements		Compliance YES/NO
1.	Image sensor	1/2.9" Progressive CMOS or better	
2.	Maximum resolution	1920 x 1080 (2MP)	
3.	Lens type	Fixed-focal	
4.	Focal length	f = 2.8 mm	
5.	Aperture	F1.8	
6.	Field of view	105° (Horizontal)	
		60° (Vertical)	
		109° (Diagonal)	
SN	**Technical specifications/requirements**		**Compliance YES/NO**
7.	Shutter time	1/5 sec. to 1/30,000 sec or better	
8.	Day/night	Removable IR-cut filter for day & night function	
9.	Min. illumination	Colour: 0.01lux (F1.4, AGC ON)	
		B/W: 0.004lux (F1.4, AGC ON)	
		0 lux with IR on	
10.	Pan/tilt/zoom functionalities	ePTZ:	
		48x digital zoom (4x on IE plug-in, 12x built-in)	
11.	IR illuminators	Built-in IR illuminators, effective up to 20 meters or better	
		with Smart IR	
		IR LED*8	
12.	On-board storage	Micro SD/SDHC/SDXC card slot	
		Seamless recording	
	Video		
13.	Compression	H.264 & MJPEG	

14.	Maximum frame rate	30 fps@ 1920x1080 in both compression modes	
15.	Maximum streams	4 simultaneous streams or better	
16.	S/N ratio	65 dB	
17.	Dynamic range	65 dB	
18.	Video streaming	Adjustable resolution, quality and bitrate	
19.	Image settings	Time stamp, text overlay, flip & mirror; configurable brightness, contrast, saturation, sharpness, white balance, exposure control, gain, backlight compensation, privacy masks; Scheduled profile settings, 3D noise reduction, video rotation, defog	
	Network		
20.	Users	Live viewing for up to 10 clients	
SN	Technical specifications/requirements		**Compliance YES/NO**
21.	Protocols	IPv4, IPv6, TCP/IP, HTTP, HTTPS, UPnP, RTSP/RTP/RTCP, IGMP, SMTP, FTP, DHCP, NTP, DNS, DDNS, PPPoE, CoS, QoS, SNMP, 802.1X, UDP, ICMP, ARP, SSL, TLS	
22.	Interface	10 Base-T/100 Base-TX Ethernet (RJ-45)	
23.	ONVIF	Supported	
	Intelligent video		
24.	Video motion detection	Five-window video motion detection	
25.	Alarm and event		
26.	Alarm triggers	Motion detection, manual trigger, periodical trigger, system boot, recording notification, camera tampering detection	
27.	Alarm events	Event notification using HTTP, SMTP, FTP and NAS server, SD Card	
		File upload via HTTP, SMTP, FTP, NAS server and SD card	
	General		

28.	Connectors	RJ-45 for network/PoE connection	
29.	LED indicator	System power and status indicator	
30.	Power input	IEEE 802.3af PoE Class 0	
31.	Power consumption	Max. 9 W	
32.	Safety certifications	CE, LVD, FCC Class B, VCCI, C-Tick	
33.	Operating temperature	Starting temperature: 0°C ~ 50°C (32°F ~ 122°F)	
		Working temperature: -10°C ~ 50°C (14°F ~ 122°F)	
34.	Humidity	0.9	
	Network video recorder		
35.	OS	Embedded Linux	
SN	Technical specifications/requirements		**Compliance YES/NO**
36.	Flash	256 MB	
37.	RAM	2 GB	
38.	Watchdog	Hardware + Software	
39.	Power restoration	System restarts automatically after power recovery	
	Storage	-	-
40.	HDD devices	Internal x 2	
41.	HDD max. capacity	8 TB x 2	
42.	Disk management	Create, format and remove disk, HDD S.M.A.R. T	
	Video	-	-
43.	Video output	HDMI x 1, VGA x 1	
44.	Resolution	1920 x 1080, 1280 x 720	
45.	Graphics decoder	Hardware decoding	

46.	Decoding capacity	H.264:	
47.		2560 x 1920 @ 30 fps (1-CH) 1920 x 1080 @ 120 fps (4-CH)	
48.		1280 x 720 @ 240 fps (8-CH) 720 x 480 @ 480 fps (16-CH)	
49.	Camera position	Change the view cell position on the live view screens	
	External interface	-	-
50.	USB interface	Front: 2 (USB 2.0), Back: 1 (USB 2.0)	
51.	Alarm In	8	
52.	Alarm Out	4	
53.	Audio	1 x 3.5 phone jack audio output 1 x 3.5 phone jack audio input (reserved)	
54.	External HDD	1 x east port	
55.	RS232	1 port (reserved)	
SN	Technical specifications/requirements		**Compliance YES/NO**
56.	RS485	1 port (reserved)	
	Network	-	-
57.	Network interface	10/100/1000 Mbps ethernet (RJ-45) x1	
58.	PoE	8x 802.3af compliant PoE ports (Total Max. 80 W)	
59.	Protocols	IPv4, TCP/IP, HTTP, HTTPS, UPnP, RTSP/RTP/RTCP, SMTP, FTP, DHCP, NTP, DNS, DDNS, IP Filter	
	LED indicator	-	-
60.	LED indicator	Power, status, record, HDD1, HDD2, eSATA, ethernet, Port1~Port8	
	Mechanic	-	
61.	Operating temperature	0°C ~ 40°C (32°F ~ 104°F)	
62.	Humidity	0 ~ 95%	

	Client PC requirements		
63.	Operating system	Microsoft windows 10 or latest	
64.	CPU	Intel i5 or better	
65.	Memory	16 GB or above	
66.	Ethernet	10/100 Mbps	
67.	Display resolution	1024 x 768 pixels or above	
68.	Web browser	Internet Explorer 10 (32 bit) or above	
69.	Software AP	Installation Wizard 2, ST7501, VAST	
70.	Mobile/Tablet app	Support iOS/Android	
	Accessories		
71.	Others	Power adapter, power cord, quick installation guide, 16 x H.D.D. screws, 4 x H.D.D. brackets, 1 x USB mouse, 2 x SATA cables	
	Software information		
	Record		
72.	Maximum channel	16	
73.	Record throughput (MB)	96 Mbps	
74.	Network throughput (MB)	24 Mbps	
75.	Audio format	G.711, G.726	
76.	Video format	MJPEG, H.264	
77.	Video resolution	VGA, 1MP, 2MP, 3MP, 5MP & 12MP Camera	
78.	Array type	RAID 0, 1	
79.	Recording time (sec.)	Pre-record: 5 (max. 10)	
80.		Post-record: 20 (max. 300)	

81.	Recording stream	Single	
82.	Recording mode	Continuous, schedule, manual, event,	
83.		activity adaptive streaming	
84.	Recording setting	Recycle (unit: day)	
85.	Recording path	Local path	
86.	Record video format	3GP	
87.	Monitor enhancement	OSD display (NVR), OSD display (Camera), camera information, remote I/O Control, event notification, aspect ratio	
88.		Fisheye dewarp: 1O,1P,1R,1O3R,1O8R	
89.	PTZ control	Panel control	
90.	PTZ operation	Direction control, home, iris, preset, patrol (Group), PiP control	
	Playback (local display)	-	
91.	Playback display	4 Channels	
92.		Multiple layout display: 2x2	
93.	Playback control	Regular (Play, Pause, Stop), rewind, next / previous frame, speed control, calendar, event, timeline, timeline scale, thumbnail (storyboard)	
94.	Video search	By calendar, date/time, and alarm	
95.	Thumbnail explorer (storyboard)	Listing the thumbnail of recorded video (Max. 2 CH)	
96.	Monitor enhancement	OSD display (Camera), event notification, aspect ratio, PiP control, fisheye dewarp (1O,1P,1R,1O3R)	
97.	Snapshot	JPEG	
98.	Video clip export	EXE	

	Live View (remote)		
99.	Stream application	Stream selection	
100.	Audio capability	One way	
101.	Live view display	16 channels	
102.		Multi layout display:	
103.		1x1, 2x2, 3x3, 4x4, 1+3, 1+5, 1+12	
104.	Monitor enhancement	OSD display (NVR), drag &drop, image freeze, audio control, remote I/O control, event notification, bookmark, fisheye dewarp (1O, 1P, 1R)	
105.	PTZ control	Panel control	
106.	PTZ operation	Direction control, home, zoom, focus, Iris, preset, patrol (group), PiP control	
107.	Snapshot	JPEG	
	Playback (remote)		
108.	Playback display	4 Channels	
		Multi layout display:	
	Alarm management		
109.	Schedule type	Continuous, schedule, manual	
SN	Technical specifications/requirements		**Compliance YES/NO**
110.	Event	Motion detection, PIR detection, tampering detection, digital input (camera), digital output (camera), connection abnormal, storage abnormal, storage full, camera network loss, DI, DO	
111.	Action	Record, email (text), email (snapshot), FTP, buzzer, PTZ control (go to preset), NVR DO, camera DO	
112.	Recording time (sec.)	Pre-Record: 5 (max. 10), post-record: 20 (max. 300)	

	Backup		
113.	Manual	USB dongle (FAT format)	
114.	System		
115.	User management	User account: 16 users	
		Account time limit: 10 mins	
		User level: administrator / regular user	
		User feature definition: by camera	
116.	Log	System, recording, user, error	
117.	Date& time	Time zone, manual, automatic sync NTP, daylight saving time	
118.	Firmware	Manual update	
119.	Restore default	To be supported	
120.	Backup/Restore (Configuration)	To be supported	
	Camera integration		
121.	Insert camera	manual, search	
122.	Video (media) setting	Compression, resolution, FPS, video quality	
123.	Image setting	Image display image adjustment	
124.	PTZ control	Panel control	
125.	PTZ operation	Direction control, home, preset, patrol (group)	
126.	Motion detection	Supported	
127.	ONVIF stream	video (H.264 & MJPEG)	
128.	ONVIF recording	Continuous, schedule, manual	
	Rodent repellent system		
	Panel specification		
1.	· Configuration: URRS - 12T main console		

2.	· Operating frequency: between 20Khz to 50Khz auto sweep	
3.	· Frequency generation: Voltage controlled oscillator (VCO)	
SN	Technical specifications/requirements	**Compliance YES/NO**
4.	· Transducer test: “Test Transducer” menu selection	
5.	· Ventilation: Mini exhaust fan	
	Transducer specification	
1.	· Ultrasound generator: Piezo electric disc type transducer	
2.	· Power O/P transducer: minimum 800mW	
3.	· Sound pressure: 80dB to 110dB (at 1 meter)	
4.	· Transducer housing: ABS plastic with mounting base	
	Water leak detection system	
1.	A system for early detection of water leaks at locations in any water-dependent appliance and apparatus used in buildings such as homes, townhouses, apartments, mobile homes, and offices. A central control apparatus electrically interconnected with a plurality of circuits which enable water leaks to be accurately detected in a diversity of devices including air conditioners, compressor coils, hot water appliances, and pipes, and for communicating the severity of the water-related problem. A plurality of water sensors is incorporated into specially designed probes of the preferred embodiment wherein water leaks may be accurately and reliably detected in a diversity of water-dependent appliances and devices. The product shall be designed and should be easily installed and to be inherently devoid of any safety hazards. The total area under protection shall be divided into multiple zones. When there is a potential leak detected, the product shall be able to locate the zone(s) in which the leak has occurred with the corresponding zone name.	

2.	Main control panel: The main control panel shall be a microcontroller based intelligent system capable of accepting 4 / 8 sensor cables. The system shall have LCD / LED display unit and keypad for user interface. The sensing technology shall be AC excitation and shall not use DC supply for leak detection. The AC excitation is preferred because of sensor cable getting degraded due to scale formation due to the electrolysis associated when DC excitation. The panel shall have potential free relay outputs for fire, fault, hooter etc. Individual alarm relay output shall be provided for each zone. The panel shall have MODBUS connectivity built in and shall communicate to any BMS for integration. All necessary hardware, interface card shall be included in the panel. No external module shall be connected to the main panel for leak detection.	
DISASTER RECOVERY CENTRE INFRASTRUCTURE MONITORING SYSTEM		
SN	**DCIM requirements**	**Compliance YES/NO**
1.	a) The proposed 100% web based DCIM should have following modules:	
	a. Inventory manager	
	b. Change planner	
	c. Thermal systems manager	
	d. Site manager	
	e. Power system manager	
	f. Energy insight	
	g. Process manager	
	b) Proposed DCIM shall provide mobile device capability preferably iOS solution. It shall enable barcode and device recognition for easy inventory management. It shall include an audit capability, so user can scan and asset and quickly determine correct or incorrect placement of the device.	
	c) Proposed DCIM should have a single platform with combination of application server and database server with data collection engine.	
	d) The solution should have symbols library more than 10,000 vendor-neutral symbols. All managed device symbols must include physical dimensions, rated capacities, consumption of space, power and cooling and any other associated manufacturer's data.	
	e) Proposed DCIM solution should support complex business process mapping based on requirement. Example: - commission, de-commission, add and modify.	

	f) Thermal heat map - should visualize thermal data in the form of heat maps in a 3D rendering of the floor view. And should allow to view actual rack heat load and to help balancing and optimizing the system and generate reports.	
	g) Proposed DCIM solution should have capability to provide console management of virtual and physical servers and serial devices.	
	h) DCIM should have capability to customize dashboard as per customer requirement.	
	i) Dynamic single line diagram should enable logical mapping from LT/ HT panel to IT equipment and provide exact alert/alarm can be pinpoint problems through this solution.	
	j) The solution shall support all levels of role-based access control and fine grain authorization for each functional department.	
2.	The DCIM system should be open, ecological, and modular.	
3.	The system should be open and support the following interface protocols: Common open standard protocols, such as Webservice API, SNMP, Modbus, and BACnet, facilitate quick capacity expansion in the future.	
4.	**Data accuracy** When the hardware and monitoring devices are not faulty, the false positive rate of the system must be less than 0.1%. The data and alarms reported by the system must be accurate. The precision of the data displayed on the monitoring terminal should meet relevant requirements. The alarm accuracy should reach 100%. The control accuracy of the monitoring system is 100%. The specific requirements are as follows: □ DI: Accuracy 100%; □ DO: Accuracy 100%;	
5.	The system must provide a centralized monitoring page in a unified style and provide 3D visual interface, link topology, and temperature map. Disaster Recovery Centre provides a 3D model for devices in the Disaster Recovery Centre, such as air conditioners, UPSs, cabin etc.	
6.	The system must accurately manage all alarms of the entire Disaster Recovery Centre, display the alarm information reported by each monitoring subsystem in a centralized manner, and report the concurrent alarms of multiple locations and events. The alarm information is not lost, and the alarm accuracy is 99.9%.	

	Report management The system must provide various report capabilities. The system can display monitoring data in various reports or export various reports as required. The requirements are as follows: The system must have a built-in report function. External programs or third-party systems cannot be used to manage reports. Predefined report templates are required, including capacity reports, energy consumption reports, alarm reports, and change work order reports. The system supports both instant reports and periodic reports, and has a complete report email sending mechanism. It has powerful data collection and presentation capabilities. The system allows users to create report tasks to execute required reports and send reports to specified users by email. The system provides the function of customizing report templates. Users can customize reports based on industry characteristics and maintenance requirements.	
7.	**User rights management** The system must provide the user right management function. The system can divide rights based on user roles to facilitate rights- and domain-based management. The specific requirements are as follows: Assign rights to users. For example, you can set the interfaces that can be viewed by each user account and the parameters of the devices to be viewed. The user grouping function is provided. The system rights of multiple user accounts can be managed by group. The access permission of the client computer must be set. The authorization and time period for the computer in a certain area to access the system must be set. The access rights of mobile terminals must be set. Unauthorized mobile terminals cannot directly access the system, preventing unauthorized users from accessing the system APP. In addition, the system must support the LDAP technology to authenticate users on a third-party authorization server to implement centralized user management for multiple software. In addition, the system can verify the validity and rights of users to ensure that only authorized users can access the DCIM system.	

8.	**Log management** The system provides comprehensive log management functions so that maintenance personnel can check historical events later. The logs must contain at least user login logs, user operation logs, system running logs, and device fault logs. The requirements are as follows: Provides the security log function to record event information related to security events to ensure system security. For example, account login, logout, locking, unlocking, and account addition, deletion, and modification. The system log function is provided to record system running information, such as abnormal status, abnormal actions, and data synchronization failures during system running. The log management provides the operation log function to record operations performed by users on the client, such as deleting, modifying and creating a device, and setting operations on the client.	
9.	All log data cannot be modified, and logs can be queried and exported.	
	ELECTRICAL SYSTEM	
SN	**Technical specifications/requirements**	**Compliance YES/NO**
1.	STANDARDS AND CODES	
2.	Updated and current. Standard specifications and codes of practice will apply to the equipment and the work covered by the scope of this contract.	
3.	Low voltage switchgear assemblies IEC61 439-1 & 2	
4.	Low voltage switchgear & control gear	
5.	EC 60 947	
6.	Part I: General rules	
7.	Part II: Circuit breakers	
8.	Part III: Switches, disconnectors, switch disconnectors and fuse combination units	
9.	Part IV: Contactors and motor starters	
10.	Part V: Control circuit devices and switching elements	

11.	Degree of protection of enclosures for low voltage switchgear. IEC60529 /, internal arc – IEC 61641 V2	
12.	Internal arc – IEC 61641 V2	
SN	Technical specifications/requirements	**Compliance YES/NO**
	SWITCHBOARDS	
1.	The LV switchboards shall be as per the standards IEC 61439-1 & 2. The switchboards and the associated equipment including switchgear, control gear, busbar supports, busbar orientation, busbar links etc shall be identical in construction to the assembly which has undergone the type test. The drawings of the type-tested assemblies shall be made available for inspection.	
2.	The designs of the switchboards should be with switchgear manufacturer, and all the mechanical drawings must be available in the factory beforehand.	
3.	Only OEM design model panels shall be supplied.	
4.	Switchboards shall have a short circuit level withstand as per schedule of quantities and drawings.	
5.	Panel shall be tested of design as per seismic zone 4 of IEC 60068-3-3 requires compliance against 0.4g acceleration	
6.	The enclosures shall be designed to take care of normal stress as well as abnormal electro-mechanical stress due to short circuit conditions. All covers and doors provided shall offer adequate safety to operating persons and provide ingress protection of IP 42 unless otherwise stated. Ventilating openings and vent outlets, if provided, shall be arranged such that same ingress protection of IP 42 is retained. Suitable pressure relief devices shall be provided to minimize danger to operator during internal fault conditions.	
7.	LT panel shall be ready with ethernet (TCP/IP) communication i.e., Switchgears (ACB & MCCB) status (On/Off & Trip) and multi-function meters (MFM) parameters shall be available on ethernet communication inside the LT Panel) ready monitoring at BMS/EMS level.	

8.	In case of ACB/MCCB with communication port, the release metering data shall be available on ethernet. Panel builder shall include all necessary hardware's in their scope to make LT panel ethernet ready and submit communication test report during panel testing at shop floor. Communication hardware's should be plug & play, non-PLC type, with no programming requirement, with built-in web pages, EMC/EMI certified to be installed in electrical panels.	
9.	The switchboard along with ACBs and connections should have been typing tested design at CPRI /Independent international test house for short circuit, temperature rise, protective earth short circuit test and dielectric tests of the ratings required.	
10.	Panel shall be rated for impulse withstand capability equal to or greater than the switchgears inside the panel i.e., 12kV	
11.	For operator safety IP2 X (touch proof) protection to be available even after opening the feeder compartment door. The compartmentalization to be achieved by using metal separators, use of PVC sheet / hylem sheets shall not be allowed.	
12.	For operator safety IP2 X (touch proof) protection to be available even after opening the feeder compartment door. The compartmentalization to be achieved by using metal separators, use of PVC sheet / hylem sheets shall not be allowed.	
13.	Main switchboard shall be form 4b, for form of separation only metallic covers shall be used, hylem / PVC sheets shall not be allowed**,** rest of the panels shall be minimum conform to form 3b design**.**	
	SWITCHBOARD CONFIGURATION	
1.	MAIN LT PANEL : Design, fabrication, assembly, wiring, supplying, installation, testing and commissioning of front operated cubicle type compartmentalised front access free standing, dust and vermin proof (IP 21 ingress protection) switchboards suitable for use at 400 volts +/-10%, 3 phase 4 wire 50 hertz system suitable for fault level of required value symmetrical at 400 volts +/-10%, fabricated from 2 mm thick CRCA MS sheets with hinged, gasketed (metal based neoprene) and lockable doors having structural reinforcement with suitable angle/channel/T/flat sections including 3 mm thick gland plates on top and bottom and including lifting hooks and GI earth strip of required size with 2 no's earthing terminals and powder coated paint finish of approved shade over metal surface cleaned and treated with seven tank process complete with interconnections etc as per specifications, as required and as below. MCCB and MCB operation at 400V AC, and the insulation need to be at 690V AC, all	

	panels shall be duly metal labelled with schematic diagram and danger marks. Complete as required.	
2.	All panel/switchboards shall have provision for entry of cables from the top and bottom as required.	
3.	All live accessible parts shall be shrouded and all equipment's shall be finger touch proof. The busbars insulation shall be with heat shrinkable sleeves. SMC/DMC shrouds and busbar supports shall be used.	
4.	All meters shall be digital type with LED display.	
5.	Operations logic to be decided and approved by NEA before GA drawing submission by bidder.	
	Incomer:	
1.	Minimum. 2 no 800 amps 4 pole ACB (50KA) with trip setting at 40 to 100% and terminals suitable for cable connections on one side and bus bar connection on the other side, as per specifications and complete with inbuilt protections (UV, OV, EF, SC and OL) and as required at site of work. (With current setting plugs). Calculations required during DDE.	
	Metering, indication &protection:	
1.	2 sets of R, Y, B phase indicating lamps with neutral link with control MCB. (3x2A).	
2.	ON-OFF-TRIP indication lamps with control MCB (3x2 A)	
3.	Multi-function meter (equivalent to EM 6400) with CT -800/5A, 15VA, CL-1.0.	
	BUSBAR SECTION:	
1.	Minimum. 1000 amps 4 strip (50KA) busbar chamber of suitable length and cross-sectional area with AL busbars with colour coded and shrouded. All busbars and interconnections shall be of suitable size (AL) at 1.5 amps/Sqmm. Neutral bar shall be of the same size as phase bar.	
2.	Metering, indication &protection:	
3.	ON-OFF-TRIP and all phase with neutral indication lamps with control MCB (3x2 A)	
	Tie breaker:	

1.	Providing installation, testing and commissioning of minimum 1 No 800 amps 4 pole ACB (50KA) with trip setting at 40 to 100% and terminals suitable for cable connections on one side and bus bar connection on the other side, as per specifications and complete with inbuilt protections (UV, OV, EF, SC and OL) and as required at site of work. (With current setting plugs).	
	OUTGOING: minimum value provided. The qty. may vary during DDE.	
1.	Two (2) nos. 300A, 4pole MCCB (25 KA) with ON-OFF-TRIP indication lamp with MCB control lamps, EM 6400, CT 300/5A, CL-1, 15VA Cts. complete as required.	
2.	Two (2) nos. 200A, 4pole MCCB (25 KA) with ON-OFF-TRIP indication lamp with MCB control lamps, EM 6400, CT 200/5A, CL-1, 15VA Cts. complete as required.	
3.	Two (2) nos. 160A, 4pole MCCB (15 KA) with ON-OFF-TRIP indication lamp with MCB control lamps, EM 6400, CT 160/5A, CL-1, 15VA Cts. complete as required.	
4.	Three (3) nos. 63A, 4pole MCCB (25 KA) with ON-OFF-TRIP indication lamp with MCB control lamps, EM 6400, CT 63/5A, CL-1, 15VA Cts. complete as required.	
5.	The main panel must have the AMF facility inbuilt for DG operation, load management, micro-PLC etc for performing the sequential operation logic.	
	UTILITY PANEL: minimum value provided. The qty. may vary during DDE.	
	Incomer	
1.	One (1) no. 250 A, 4P MCCB (25 KA) with ON-OFF-TRIP indication lamp with MCB control lamps, EM 6400, 250/5A, CL-1, 15VA CTs. complete as required.	
2.	Busbar AL 300A	
	Metering, indication &protection:	
1.	1 set of R, Y, B phase indicating lamps with neutral link with control MCB. (3x2A)	
2.	ON-OFF-TRIP indication lamps with control MCB (3x2 A)	
3.	Multi-function meter (equivalent to EM 6400) with CT -300/5A, 15VA, CL-1.0	
	Outgoing	
1.	6 no's 63A 4 pole MCB	
2.	4 no's 32A 2 pole MCB	
SN	Technical specifications/requirements	**Compliance YES/NO**

	APFC PANEL: minimum value provided. The qty. may vary during DDE.	
	GENERAL	
1.	Design, fabrication, assembly, wiring, supplying, installation, testing and commissioning of front operated cubicle type compartmentalised front access free standing, dust and vermin proof (IP 20 ingress protection) switchboards suitable for use at 400 volts +/- 10%, 3 phase 4 wire 50 hertz system suitable for fault level of required value symmetrical at 400 volts +/- 10%, fabricated from 2 mm thick CRCA MS sheets with hinged, gasketed (metal based neoprene) and lockable doors having structural reinforcement with suitable angle/channel/T/flat sections including 3 mm thick gland plates on top and bottom and including lifting hooks and including GI earth strip of required size with 2 no's earthing terminals and including powder coated paint finish of approved shade over metal surface cleaned and treated with seven tank process complete with interconnections etc as per specifications, as required and as below. MCCB and MCB operation at 400V AC +/-10%, and the insulation need to be at 690VAC, all Panels shall be duly metal labelled with scheme diagram and danger mark with 400V AC operation.	
2.	All panel/switchboards shall have provision for entry of cables from the top and bottom as required.	
3.	All live accessible parts shall be shrouded and all equipment shall be finger touch proof. The busbars insulation shall be with heat shrinkable sleeves. SMC/DMC shrouds and busbar supports shall be used. Padlocking facility shall be provided on all outgoing feeders doors and switch handles shall be lockable in OFF position.	
4.	All kA values indicated shall be Ices breaking capacity.	
5.	APFC control circuit stage load based.	
6.	Incomer 160A 4P MCCB 25kA CCB with thermal overload, magnetic short circuit release	
7.	160/5 - 15 VA class - 1CTs to be added in panel along with control wiring 4C2.5Sqmm Cu FRLS wire for Sensing (3 CTs for 3P +1 CumCT)	
	BUS BAR	
1.	Electrolytic high conductivity aluminium three phase and neutral busbars rated at 250 amps having a maximum current density of 1 amp per sq. mm suitable to with stand symmetrical fault level of 25 kA. at 400 volts. The neutral busbar is to be of 100% capacity.	

	Indicators	
1.	3 Phase (R, Y, B indicator lamps with control MCB)	
2.	ON/OFF/Trip indication (R, Y, An Indicator lamps with control MCB)	
3.	1 no. 96 mm sq. digital multipurpose voltage, current, frequency meter with 3 way and OFF selector switch with Kvar, Kw, KVA, Pf, Cf display, if CTs required same shall be taken into consideration.	
4.	The switchboard shall be extensible complete with all interconnections, risers, internal wiring, labels etc complete as required 3 phase load-based sensor and switching.	
5.	1 set of red/green indicating lamp to give status of the circuit in each capacitor.	
6.	1 set of manual ON/OFF push buttons.	
7.	2x25 KVAr, 2x15 KVAr, 2x10KVAr hermetically sealed metallized polypropylene capacitor units complete with fuse protection, discharge resistors, adequate MCBs with copper links, ON/OFF button switches, Indicators and interconnections etc complete as required.	
8.	CABLE: Supply, storing, handling, laying, testing and commissioning of 1100 Volt grade XLPE insulated and sheathed aluminium conductor armoured cables, ISI marked, including providing required gap between adjacent cables (minimum one cable dia.) including providing identification tags in shaft/ cable trays etc. complete as per specifications, as required (low v/d losses).	
	ALUMINIUM	
1.	The aluminium conductor used shall be of H-4 grade (tensile strength above 150 N/mm2). High conductive aluminium, stranded (class-II, stranded circular shaped), uniform in quality and free from scale, inequalities, spills, splits and other defects. The aluminium used shall have purity meeting the criteria for maximum resistance allowed. Two sample conductors randomly selected from finished lot of cables, shall be tested for its purity at any 3rd party NABL accredited lab.	
	COPPER	
1.	The conductors shall be made from high conductivity copper rods complying with IEC: 60228. The conductor material used shall be electrolytic grade with high purity. Two sample conductors randomly selected from finished lot of cables, shall be tested for its purity at any 3rd party NABL accredited lab.	

SN	Technical specifications/requirements	Compliance YES/NO
	Cable joints:	
1.	Joints shall be permitted in the individual wires of which the conductor is formed, but no joint shall be within 300 mm of any other joint within the same layer. The joints shall be made by resistance butt welding, fusion welding, cold pressure welding, electric welding, gas welding, brazing or silver soldering. No joint is allowed in the conductor after stranding. A maximum of two joint shall be allowed in any strand forming complete length of the cable. The conductors shall conform to appropriate dimensions, resistance and number of wires in the conductor (number of strands) as per international Standard.	
	Insulation	
1.	The insulating material for power cables shall be extruded cross linked polyethylene (XLPE) compound as per international Standard. The minimum thickness of insulation shall not be less than the values specified as per international Standard. No negative tolerance shall be applicable for the thickness. The insulation of the cable shall be designed and manufactured for the specified system voltage. The manufacturing process shall ensure that insulation shall be free from voids. The insulation shall withstand mechanical and thermal stress under steady state and transient operating conditions. The cores shall be identified as per the following colour scheme: 3-Core - Red, Yellow & Blue 3 ½ or 4-Core - Red, Yellow, Blue & Black.	
	Inner sheath	
1.	The inner sheath shall be extruded FRLS PVC, Type ST2, compatible with thermal rating of insulation conforming as per international Standard. The sheath shall have adequate thickness, mechanical strength and elasticity. The material shall be soft thermoplastic type, applied by extrusion method.	
	Armouring	
1.	The armouring arranged over the inner sheath shall consist of one layer of galvanized round steel wires for all sizes of cable.	
	Outer sheath	
1.	Extruded outer sheath shall be provided over the armouring. The material used for sheathing shall be FRLS PVC sheath, type ST-2 base compound conforming as per international Standard for power cable. The outer sheath shall be so formed that it fits closely on the laid-up armour and could be easily removed without damaging the intermediate sheath and insulation. The colour of the outer sheath shall be black.	

SN	Technical specifications/requirements	Compliance YES/NO
1.	Light fixtures complete with energy efficient electronic ballast, control gear and all the other standard accessories.	
2.	**EARTHING:** Supply & installation of the following with clamps, inspection chambers, excavation maintenance free compound as per technical specifications &international standards. Complete. The cost shall include excavation, backfilling, compaction, construction of chambers, tools and tackles for excavation & all required civil works. Testing earth resistivity and electrode resistance (maintenance free earthing)	
	General requirement	
1.	The purpose of this specification is to provide reliable electrical grounding to equipment. The contractor should propose the number of earth pit as per site requirement. The bidder shall consider the following earth pit minimum	
2.	UPS body earth	
3.	UPS neutral earth	
4.	DG body earth	
5.	DG neutral earth	
6.	Electrical panel body earth	
7.	Tray earth rack body earth	
8.	The scope covers supply, installation testing and commissioning of earth pit. The bidder must consider the required material like sand, chemical compound, heavy-duty lid to cover the earth pit, bolt and net, bus bar etc.	
9.	**The maintenance free earth system shall consist of** a) Earth electrodes b) Highly conductive and eco-friendly backfill compound, c) Earth termination clamps to facilitate connections to the equipment.	
10.	**The earth electrode shall confirm to the following specifications:** The electrode shall be a solid steel rod made of high tensile low carbon steel and coated with molecularly bonded copper on the outside as per UL 467 or international equivalent.	

11.	**POINT WIRING: FOR LIGHT FIXTURES:** Wiring for light point/ fan point/ exhaust fan point/ call bell point with 1.5 sq.mm FRLS PVC insulated copper conductor single core cable in surface / recessed steel conduit, with piano type switch, phenolic laminated sheet, suitable size MS box and earthing the point with 1.5 sq.mm FRLS PVC insulated copper conductor single core cable etc. as required.	
	(SWITCHES &SOCKETS SHALL BE OF MODULAR TYPE)	
1.	**INDUSTRIAL TYPE SOCKETS AND PLUG TOPS:** Supply, store, erection, testing and commissioning of factory-made metal clad totally enclosed with cast aluminium housing with industrial socket/interlocked combined rotary switch and socket with scrapping earth connection and plug top. In case of interlocked socket, the interlocking should ensure that the plug cannot be inserted or withdrawn while the switch is in 'ON' position. (All switches &sockets shall be housed in painted MS boxes).	
2.	32A, 400V, 3P+N+E, IP 44 Male top with socket, plastic moulded industrial socket with suitable straight plug, surface mounted / raceway mounted type. The pricing shall include to make the required supports on the floor/raceway along with required accessories. (NEMA/IEC 309)	
3.	32A, 230V, 2P+E, IP 44 male top with socket, plastic moulded industrial socket with suitable straight plug, surface mounted / raceway mounted type. The pricing shall include to make the required supports on the floor/raceway along with required accessories. (NEMA/IEC 309)	
	Cable laying	
1.	Cable shall generally be installed in ladder type/perforate sheet type site fabricated/pre-fabricated trays except for some short run-in rigid/flexible conduit for protection or crossings.	
2.	Cables lay on trays and risers shall be neatly dressed and clamped at an interval of 1500 mm and 900 mm for horizontal and vertical cable runs. Clamps for multi- core cables shall be fabricated out of 25 x 3 mm aluminium flats.	
3.	All power cables shall be clamped individually, and control cables shall be clamped in groups of three or four cables. Prior to lying of cables inside both indoor and outdoor trenches, the selected bidder shall properly clean inside those trenches.	
4.	In addition, the cable runs both before and after the fire seals shall be suitably sprayed with anti-fire propagation liquid at least for 1M length. After completion of installation and prior to connection, all power cables shall be subjected to a high potential test.	

	Cable tag &marker	
1.	Each cable and GI/MS conduit run shall be tagged with numbers that appear in the cable and GI conduit schedules.	
2.	Cables and GI/MS conduits shall be tagged at their entrance, every 30.0M and exit from any equipment, junction box.	
3.	The tags shall be of aluminium with the number punched on it and securely attached to the cable by not less than two turns of nylon 6 cable ties.	
4.	The location of cable joints, if any, shall be clearly indicated with cable marker with an additional inscription 'cable-joint'. The selected bidder shall furnish and install all tags and markers stated above. For buried cable, the marker shall project 150 mm above ground and shall be spaced at an interval of 30 meters and at every change of direction.	
	Cable termination	
5.	The termination and connection of cables shall be done strictly in accordance with manufacturer's instruction, drawings and/or as directed by the engineer in charge The work shall include all clamping, fitting, fixing, cable jointing, crimping, shorting and grounding etc. as required for heat/cold shrinking technology for the complete job.	
	UPS AND BATTERY SYSTEM	**Compliance YES/NO**
1.	**UPS for Critical load**: For disaster recovery centre IT load, the bidder should provide 2 nos. (N+N) UPS, Capacity of 600 KVA and scalable upto 900 KVA@ 0.9 pf (IGBT based) type Uninterrupted Power Supplies (UPS) to provide 3 phase/ neutral AC to the desired load. The UPS should be online double conversion and fully redundant with at least N+N configuration. The back-up time should be at least 15 minutes for full load operation during which alternative feed should provide the input power.	
	Mode of operation	
2.	**Normal:** The input converter and output inverter should operate in an on-line manner to continuously regulate power to the critical load. The input and output converters should be capable of full battery recharge while simultaneously providing regulated power to the load for all line and load conditions within the range of the UPS specifications.	

3.	**Battery:** Upon failure of the AC input source, the critical load should continue being supplied by the output inverter, which should derive its power from the battery system. There should be no interruption in power to the critical load during both transfers to battery operation and retransfers from battery to normal operation.	
4.	**Recharge:** Upon restoration of the AC input source, the input converter and battery charger should recharge the battery and output converter should continue to provide regulated power to the critical load.	
5.	**Static bypass:** The static bypass should be used to provide transfer of critical load from the Inverter output to the bypass source. This transfer, along with its retransfer, should take place with no power interruption to the critical load. This transfer should be an automatic function.	
6.	The scope should include supply, transportation, storage, unpacking, erection, testing, successful commissioning and satisfactory completion of trial operations of the full capacity of DRC's critical load kVA/kW UPS in 2N Configuration systems for Disaster Recovery centre. The UPS should be scalable to minimum 100% KW/KVA by adding additional UPS modules in the one or multiple frames.	
7.	Each UPS should have hot swappable replaceable minimum 50 kW / kVA power module shall contain a fully rated, power factor corrected input rectifier/boost converter hereafter referred to as the PFC input stage, a fully rated output inverter, battery charging circuit and field replaceable fans. Power module fans shall be variable speed controlled and capable of maintaining the system in the event of a single fan failure. The system shall also be comprised of a continuous duty bypass static switch module, redundant control modules, redundant logic power supplies, and touch screen user interface/display. Hot Swappable-replaceable battery modules should be provided along with UPS.	
	AC Input voltage window:	
1.	±15 percent for full performance (340 to 460 volts at 400 volts)	
2.	Operating ambient temperature: 0°C to 40°C	
	Input power factor:	
3.	1) Greater than 0.99 with load at 100 percent.	
4.	2) Greater than 0.98 with loads above 50 percent.	
5.	3) Greater than 0.97 with loads above 25 percent.	

6.	Relative humidity: 0 to 95%, non-condensing.	
7.	Operating altitude with no de-rating: 0 to 1000m feet above sea level.	
	Overload rating:	
8.	1) **Normal operation:**	
9.	a) 150 percent for 60 seconds before transfer to bypass.	
10.	b) 125 percent for 10 minutes before transfer to bypass.	
SN	Technical specifications/requirements	**Compliance YES/NO**
11.	2) **Battery operation:** 125 percent for 30 seconds (up to 10 minutes with fully configured battery solution)	
12.	3) **Bypass operation:**	
13.	a) 110 percent continuous at 400 volts.	
14.	b) 170% percent for 10 minutes	
15.	c) 1000 percent for 100 milliseconds.	
16.	Input power factor: 0.99	
17.	Input current distortion with no additional filters.	
18.	< 3% THD at 100% linear load	
	System AC-AC efficiency:	
19.	1) Normal operation: > 95 percent at 40 percent to 100 percent load.	
20.	2) Battery operation: > 95 percent at 40 percent to 100 percent load.	
21.	Output Power Factor Rating: 0.5 leading to 0.5 lagging without any derating in kVA capacity.	
	International Electrotechnical Commission (IEC):	
22.	1) Low Voltage Directive: 2006/95/EC with the amendment directive 93/68/EEC directive for electromagnetic compatibility 2004/108/EC	
23.	2) General and safety requirements for UPS used in operator access area: IEC/EN 62040-1-1 incorporating requirements of IEC/EN 60950	



24.	3) Electromagnetic compatibility (EMC) requirements for UPS: IEC/EN 62040-2: immunity category C2, emission category C2	
25.	4) IEC 62040-3, "Uninterruptible Power Systems - method of specifying the performance and test requirements.	
	The UPS should have redundant controllers	
26.	Modular batteries: should be designed for 15 minutes back up at full load on each UPS.	
27.	Standard battery technology should be 12 V SMF valve regulated lead acid (VRLA). Batteries to be connected in parallel. Batteries should be housed in the same rack as the power section or separate rack. The UPS battery should be of modular construction made up of user replaceable, hot swappable, batteries should be modular on pull out shelves for quick replacement and servicing. In event of failure of any single battery only battery backup time must reduce and should not become zero.	
28.	Battery charge current limit: The UPS should limit the energy sourced from the mains for purposes of battery charging. The battery charging circuit should remain active when in static bypass and in normal operation.	
	DISPLAY, CONTROLS AND ALARMS	
1.	A microprocessor-controlled display unit should be located on the front of the system.	
2.	The display unit should allow the user to display an event log of all active alarms and most recent status and alarm events.	
3.	The following minimum set of alarm conditions should be available:	
4.	Inverter fail	
5.	EPO active	
6.	Bypass mode	
7.	Battery mode	
8.	Battery low pre-warning	
9.	Source share mode	
10.	Battery replaced	
11.	Normal mode	

12.	Battery period testing	
13.	Battery capacity testing	
14.	UPS system testing	
15.	Bypass abnormal	
16.	Mains volt. Abnormal	
17.	Battery end of discharge	
18.	Fan fault	
19.	DC bus over voltage	
20.	DC bus abnormal	
21.	Battery over-temperature	
22.	Ambient over-temperature	
23.	Output overloaded	
	UPS system for non-critical load	
1.	Modular UPS as per approved design of DRC 150 KVA @ 0.9 pf for the non-critical load such as air-conditioning equipment, lighting, and other IBMS systems must have following features. The UPS must be in N+N (2N) configuration with 30 minutes back up on each UPS at full resistive load.	
2.	IGBT based UPS with high efficiency and power quality.	
3.	**Output crest factor**: 3:1 without derating of output.	
4.	**Output voltage distortion:** £ 5% for linear and non-linear loads;	
5.	**Efficiency:** Overall efficiency of each UPS unit shall be greater than or equal to: 94% @ full load.	
6.	Noise level: less than: 65 dbas.	
7.	**Overload capacity:** The UPS shall be capable of supplying for at least:	
8.	10 minutes @ 125% of the rated load;	

9.	1 minutes @ 150% of the rated load;	
	Standards	
10.	IEC 62040-1 and EN 62040-1: UPS - safety.	
11.	IEC 62040-2 and EN 62040-2: UPS - electromagnetic compatibility - [level C3 / C2 class A is optional].	
12.	IEC 62040-3 and EN 62040-3: UPS - performance.	
13.	CE marking.	
	Smart bus way for IT racks (modular)	**Compliance YES/NO**
14.	smart busway is flexible in configuration, easy to install and can be expanded online, space saving, and improving the revenue of Disaster Recovery Centre. In addition, the smart busway introduces the digital management technology, which provides functions such as electrical parameter measurement and risk warning to ensure the security of the power supply and distribution system in the Disaster Recovery Centre.	
	Main input circuit breaker	
15.	The specified unit will be equipped with a main input circuit breaker for each source to provide over current protection and a means for disconnecting all power to the unit. The main input circuit breaker will be a three-pole moulded case circuit breaker sized for 125% of the specified full load input current and rated for 400 VAC. The main input circuit breaker will include a 24 VDC shunt trip mechanism to interface with unit controls, and other remote controls as required by the NEC and local codes.	
	Output distribution panel boards	
16.	The specified system shall contain 8 vertically mounted output hot swappable power modules for distribution to the intended loads. Each distribution module will provide a total of 18 single-pole branch circuit breaker positions or as required. The panel board will include separate and common isolated neutral and safety-ground busbars for the neutral and safety-ground connections to match the number of output circuits. The neutral busbar and wiring shall be sized for at least 1.73 times the panel board's full load rating.	
	Branch circuit breakers	

17.	Each load will be protected by an individual modular hot pluggable branch circuit breaker as shown on the plans i.e., single and three-pole type branch breakers. Each branch circuit breaker will provide overcurrent protection and shall clearly indicate the ON, OFF and TRIPPED positions. Branch circuit breakers will have an associated directory label, located adjacent to the breaker, identifying the branch circuit number and the equipment being served. It will be capable to replace or adjusted it online to make phase balance. Minimum 1P：40/63A x 6；3P：16/40A x 2	
SN	Technical specifications/requirements	**Compliance YES/NO**
	Power monitoring system	
18.	It will be featured with a high resolution and high sensitivity touch screen display designed based on the cortex A8 processor, allowing for user friendly interaction. Menu-driven LCD allows the user to easily browse the input and output parameters, acquire status and alarm messages, and perform corresponding parameter settings of the PDU unit. It will also display the real time power flow diagram showing the system status and alarm messages. It should be able to store up to 10000 historical events that will be easily retrieved to realize the root cause of faults. It will be able to monitor on centralized monitoring system using a MODBUS/SNMP protocol.	
	Monitored parameters	
	The monitoring system shall monitor and display all of the following parameters:	
1.	Source Information – line voltage, phase voltage, current, frequency, power factor, THDi, THDv, active power, apparent power, each voltage & current harmonic percentage (up to 31st harmonics), unbalance factor, leakage current, and neutral current.	
2.	Module & sub branch Information- display the name, current working status, current, energy, each harmonic current percentage, active power, apparent power and power factor of each branch (up to 144-route)	
3.	Historical & current events	
4.	Real-time waveform of source voltages and currents	
5.	Real-time waveform of branch currents and voltages	
6.	Energy statistics	

7.	System reports	
8.	Date	
9.	Time	
10.	All three phases of the three-phase parameters will be displayed simultaneously. All voltage and current parameters will be monitored using true RMS measurements for accurate representation of non-sinusoidal waveforms typical of computers and other sensitive loads.	
SN	Technical specifications/requirements	**Compliance YES/NO**
	Alarm annunciation	
	The monitoring system shall detect and annunciate by audible alarm and alarm message the following conditions:	
1.	Overvoltage	
2.	Under voltage	
3.	Phase loss	
4.	Overcurrent	
5.	Current exceeds high threshold limits	
6.	Current exceeds low threshold limits	
7.	Input frequency abnormal	
8.	Branch abnormal	
9.	Phase sequence reverse	
10.	Neutral overcurrent	
11.	Ground overcurrent	
12.	Output voltage distortion	
13.	Frequency deviation	

14.	Phase sequence error	
15.	Over temperature	
16.	Auxiliary power abnormal	
17.	All alarm thresholds for monitored parameters will be adjustable by way of the ethernet setup port to match site requirements. To facilitate troubleshooting, all alarms will be stored in battery-backed (non-volatile) memory until reset to protect against erasure by a power outage. Alarms will be able to be manually reset after the alarm condition has been corrected either at the unit or with the central monitoring system.	
SN	Technical specifications/requirements	**Compliance YES/NO**
	Input lightning/surge arrester	
1.	The specified unit will be equipped with a secondary-class surge arrester to divert high-voltage input power surges quickly and safely to ground. The surge arrester will be mounted ahead of all electrical components to provide maximum protection of the unit insulation and wiring. The surge arrester will be capable of repeated operations. It will consist of utility-grade metal-oxide varistors rated for up to 20,000 amps of surge current. The surge arrester will be rated for maximum FOW sparkover of 200 volts with maximum discharge voltage of 2.2 kV at 1500 amperes, assuming a standard 8 x 20 microsecond waveforms.	
	Remote monitoring &integration capabilities	
	Optional communication card	
2.	The PDU will be supplied with communication card for remote communication using SNMP/MODBUS output. Necessary accessories will be considered in the scope of supply to enable this function.	
	Power Supply System	
	The scope includes design, supply, transportation, storage, installation, testing and commissioning of the power supply related facilities up to main power distribution panel inside the facility designed to meet the uptime requirement. Bidder shall be responsible to perform the detail site survey of the existing utility power supply facility and submit the detailed design of power supply system including design and sizing of transformer, diesel generator, HT/LT switchgears, protection system, HT/LT cabling, control and monitoring units, auxiliary units and associated system with site	

	plan. The technical data sheet or guaranteed technical parameters for each component should be submitted along with site plan, layout and electrical connection diagram.	
	DIESEL GENERATOR AND ALLIED SYSTEM	
	General requirement (2 Nos.)	
1.	The generator set should have an appropriate rating to supply power continuously to a constant or varying electrical load for unlimited hours in data Centre application with uptime requirement of Tier III data Centre conforming to 2012 IBC certification. It should be enclosed with a noise attenuation system and run on diesel or biodiesel fuel. The fuel system should have a tank with transfer pump. The exhaust system should be insulated with a suitable silencer and in case of need of exhaust stack structure is required, the same may be quoted. The cooling system should be appropriate to the generator rating and local ambient conditions. The battery and charger should be suitable for the generator starting current. The generator should be equipped with suitable control, monitoring and protection system. The generator should comply with maximum permissible noise levels and emissions as per local and international regulations. The bidder shall propose the DG foundation for proposed rating as per OEM recommendation. The detail technical data sheet of the diesel generator should be submitted at the time for approval of design. These requirements are based on various standards such as ISO, NFPA, API, IEC, ANSI, and OSHA. Pre-dispatch Factory Acceptance Test (FAT) should be performed and testing and commissioning should be performed at site after installation witnessed by NEA personnels. All required components and auxiliary units including mounting base, installation, connection, testing and commissioning should be deemed to be within the scope of supply.	
2.	DG Set should be proposed for the actual and future requirements to meet load requirements of DRC and complete building including power and cooling system. DG should be suitable to supply power continuously to a constant or varying electrical load for unlimited hours in a disaster recovery centre and building. DG should deliver minimum 0 @ 0.8 PF (lagging) electrical power output at alternator terminals continuously without any interruption 24 x 7 x 365 days @ 50 deg. C. The DG rating proposed should be continuous rating conforming to 2012 IBC certification and should meet uptime requirement of a tier III disaster recovery centre. The proposed DG Set should be capable to run for unlimited hours of operation at its full capacity for 12 hours.	
SN	Technical specifications/requirements	
	Scope	

3.	This section covers the detailed requirements regarding design, manufacture, assembly, testing at the manufacturer's works, packing & forwarding and delivery up to the site, unloading and in-site shifting. Supply, erection, testing, commissioning, performance and guarantee testing of diesel gen-sets at site complete in all respects with all equipment, fitting and accessories for efficient and trouble-free operation as specified here under. The design and performance of equipment shall comply with all currently applicable statues, regulations and safety codes in the locality where the equipment going to be installed.
4.	The equipment shall be to the latest edition of applicable standard as specified. In case of conflict between applicable standards and this specification shall govern.
	The general scope of this work shall include but not limited to the following:
5.	DG set including diesel engine complete with all auxiliary and accessories, alternator directly coupled to the engine through flexible/ rigid coupling complete with all accessories for starting, regulation and control, including common base frame, interconnecting piping and accessories, power and control cable glands and lugs. DGs local (engine mounted) control panel, all housed within the acoustic enclosure as per CPCB norms. The DG set must have auto start-stop feature.
6.	Radiator of suitable capacity coupled with the engine.
7.	Equipment’s necessary for fuel distribution including day oil tank, piping, valves, and calibrated MS tank along with level switch flexible connections.
8.	Residential type silencer, exhaust system including piping, support and thermal insulation for total exhaust system.
9.	Starting batteries and battery-charging equipment, including their connections as required Set of anti-vibration mountings pad etc.
10.	The DG set shall have properly machined common base frame with grouting bolts.
11.	All the sheet metals should be processed (cutting, forming, bending, etc.) through CNC machine for fabricating and assembling acoustic enclosure, fuel tank and other allied works at the DG manufacturer’s premises.

12.	All the sheet metals to be used for the acoustic, fuel tank, etc. should be properly cleaned though 9-11(Min) tank treatment process before painting. The acoustic enclosure shall be weatherproof and rust proof when kept in open air. The fresh air inlet and the hot air outlet should be hood type placed on the top of the acoustic enclosure to improve the efficiency of air circulation and ventilation.	
	Transformers (2 Nos.)	**Compliance YES/NO**
1.	**General Requirement: -** The transformer should be suitable for use in Nepal's moderately hot and humid tropical climate and outdoor use. The supplied transformer should conform to IEC 60076. The parts and accessories like bushing, oil, core material, winding material, body material, etc used in the transformer should conform to relevant standards. The manufacturer must have valid ISO quality certification with design in its scope of registration and in-house facilities for manufacturing and testing the offered design. The rating and specification of transformer will be based on load requirement of the facility. The transformer should be installed over suitable foundation as approved. The detailed technical data sheet of the transformer should be submitted at the time for approval of design along with transformer sizing calculations. The transformer should be guaranteed for five years from the date of commissioning. The transformers should be designed for easy operation, inspection, maintenance, and repairs and should be capable of performing in continuous commercial operation in a manner acceptable to the NEA. Pre-dispatch Factory Acceptance Test (FAT) should be performed and testing and commissioning should be performed at site after installation witnessed by NEA personnels. All required components including mounting base, installation, connection, testing and commissioning should be deemed to be within the scope of the supply.	
	LT Switchgear (Transformer Control Panel)	
	Each transformer should be connected to transformer control panel at LT side with suitable sizing of ACB circuit breaker as per design requirement. It must meet specific requirements to ensure reliable and safe operation in outdoor condition. It should have a rated voltage of 400V, suitable busbars, and circuit breakers for overcurrent and short-circuit protection. It should also have appropriate cable termination and gland arrangements, an integrated metering system, and compliance with international standards such as IEC, ANSI, and IEEE. The bill of materials should be	

	included along with Technical Data Sheet. Testing and commissioning should be performed after installation, and documentation should be provided.	
	HT/LT Cables	
	All cables shall be suitable for high ambient, humid semi-tropical climatic conditions. The cables may be laid buried in standard manner and terminate for outdoor connection to a power transformer, outdoor switchgear or to overhead lines and also indoor connection for indoor switchgear. The cables may also be laid within covered cable trenches, in cable racks or open-air ladder trays etc. for certain portion of lengths. Cables shall be designed to withstand the mechanical, electrical and thermal stresses under the unforeseen steady state and transient conditions and shall be suitable for proposed method of installation. Conductor shall be of uniform, of good quality, free from defects aluminum / copper. Insulation shall be Cross Linked Polyethylene (XLPE) for both HT and LT cables. All cables should have suitable termination kits for connection to the switchgear or other electrical equipment and should be deemed included within the scope of supply. Technical Data Sheet of cables should be submitted along with cable sizing calculations.	
	Earthing and Lightning Protection	
	To protect the facility from leakage current, floating neutral, surges, odd harmonics and probable potential damages from lightning suitable earthing technique with low resistance (ideally below 2 ohm) should be designed to handle the expected fault current. The earthing system should be designed to provide adequate safety against electric shock and minimize the risk of electromagnetic interference at all points of circuit. The lightning protection system should be designed to provide a low impedance path for lightning currents to earth, preventing damage to the electrical installation and injury to personnel. The lightning protection system should include air terminals or lightning rods located at suitable intervals on the building and should be connected to the earthing system. The earthing and lightning protection system should comply with relevant international standards such as IEC, IEEE, and NFPA. The system should be tested and commissioned before handover, and suitable documentation such as equipment data sheet, test reports and as-built drawings should be provided.	
	RMU	**Compliance YES/NO**

	General Requirement: - The RMU should be designed to provide reliable and safe operation with minimal maintenance requirements. The RMU should have a rated voltage of 12kV and a rated current of as per design. It should be compact, space-saving, and have a high degree of mechanical and electrical endurance. The RMU should also have appropriate cable termination and gland arrangements, a suitable isolator, circuit breaker, switch for safe operation, an integrated metering system, and compliance with international standards such as IEC, ANSI, and IEEE. The unit shall be metal enclosed, panel type, extensible and suitable for indoor and outdoor applications. The unit shall be fully tested according to IEC 60298 standards. The RMU should be complete with all components necessary for effective operation along with all required associated equipment. All required components including mounting base, installation, connection, testing and commissioning should be deemed to be within the scope of the supply. The detail technical data sheet along with connection diagrams of the RMU should be submitted at the time for approval of design. Suitable documentation and as-built designs should be submitted after installation and testing.	
	AIR CONDITIONING SYSTEM (PAC)	**Compliance YES/NO**
1.	The following parameters shall be maintained in the DRC	
2.	Temperature: 18 Degree C (Return Air Temperature)	
3.	Humidity: 50+/- 5% RH	
4.	Ambient: 22 degree C	
5.	The cooling for the disaster recovery centre to be achieved with the help of horizontal flow in row type cooling units which should be positioned in between the IT racks which shall help to achieve maximum operational efficiency.	
6.	The entire system should be designed in accordance to latest guidelines of ASHRAE TC9.9.	
7.	The present IT load per rack to be considered as 10 kW per rack. Minimum 80-90 CFM per kW as per server requirement to be considered while proposing/designing the cooling unit.	
8.	The compressor shall be 20-100% step less modulating type brush less/ digital inverter scroll or digital scroll type with variable capacity operation from 30-100%.	

9.	The system shall be designed for use with R410A refrigerant, which meets the clean air act for phase out of HCFC refrigerants.	
10.	Units should be offered with two plug EC direct drive backward curved fan, high efficiency, EC motor with integrated electronics, maintenance free design and construction. The fan section should be designed for higher air flow. Each unit should deliver minimum 80-90 CFM per every kW of cooling as per the server actual requirement, minimum 3200 CFM per each machine. The fan should be protected from over temperature of motor, electronics, locked rotor protection, short circuit of motor output.	
11.	A manual disconnect switch, thermal magnetic circuit breakers compliant to UL 489/CSA C 22.2/IEC – 947 shall be mounted in the electrical panel and can disrupt the flow of power to the unit.	
12.	Each unit shall have minimum three factory-supplied and connected supply air sensor that may be used as a controlling sensor or reference. When multiple sensors are applied for control purposes, the user shall be able to control based on a maximum or average temperature reading.	
13.	The filters should be minimum 30% efficient per ASHRAE Standard 52.1, UL Class 2 (MERV 8 per ASHRAE 52.2) or international equivalent. Filters should be EN779 G4 efficient. The 3.75 in. (96 mm) deep, pleated filters should be replaceable from the rear of the unit.	
14.	The dual-float condensate pump shall have a minimum capacity of 8 GPH (22.7LPM @9 mtr head).	
15.	The evaporator coil should be manufactured from copper tubes with hydrophilic coated aluminium fins. Coil should be rated for a maximum pressure of 600 psig (4200 kPa), and the coils should be certified in accordance with UL207 or international equivalent. Coil header should be equipped with a stainless-steel drip plate in the bottom to capture and direct the condensation accumulating on the suction header tube to the drain pan. Coil should have multiple circuits complete with brass distributor and copper distribution tubes.	
16.	The cooling units should have adjustable baffles to adjust the airflow direction.	
17.	There should be SNMP and HTTP/Web-management capability for enhanced communications and control of HPM systems. The cards make use of an ethernet network (10/100Mbit) to monitor and control a wide range of operating parameters, alarms and notifications.	

18.	Entry and exit doors of the aisle should have open able or sliding double door.	
19.	Each door should have CRCA frame with fire retardant glass sheet of 4 mm thick or fire-retardant rigid UL V-0 plastic 3 mm. The frame of door should have 4 vertical MS columns of rectangular section with thickness of 1.5mm.	
20.	Columns should be grouted to real floor or can be fixed to the base frame of rack.	
21.	Vertical columns should be connected to each other with help of cross members. These cross members should be length of aisle width.	
22.	The doors must have a steel picture frame fabricated in 1.2 mm thick CRCA sheet as per intentional standards.	
23.	PU foam gasket should use across the metal edges of the door to prevent any leakage on cold air.	
24.	The doors should have automatic door closers installed to ensure that those are closed.	
25.	Polyamide cable brushes should be fitted at the bottom of doors to avoid leakage of cold air when doors are closed. Top panels of the cold aisle should be covered with either fire rated glass or polycarbonate panels top panels are fixed in CRCA frame per intentional standard. The glass/ polycarbonate in the top panels is of 4 mm thick.	
26.	Top panel must be tooling less installation to offer quick access to area above the contained aisle during the maintenance activity.	
27.	Top panel must have opening for smoke sensor/ FM system wherever necessary.	
28.	The powder coating complies with ROHS requirement to avoid hazardous substance contamination in the Disaster Recovery Centre. Pre-treatment nano ceramic process should be followed. The powder coating thickness is 80-100 microns.	
	Main performance of the PAC	
29.	Precision air conditioner indoor unit should be configured with DC inverter compressor, evaporator, EC fans, controller, electric expansion valve, oil separator, sight glass, dryer filter, humidifier (optional), and electric heater (optional). A high-efficiency PAC unit has cooling capacity with step less adjustments between 10 percent and 100 percent. To save energy, the cooling capacity should be adjusted	

	according to heat load. The compressor crankcase should be equipped with an electric heater to improve compressor reliability. (The report will be ready at TR6) The PAC unit should achieve stable and fast dehumidification at a minimum of 10 percent low IT load and greater than 95 percent relative humidity conditions, to avoid the condensation risk on IT equipment at extreme conditions. The electronic expansion valve can close the valve normally during sudden power-down situations. This prevents liquid flow back to the compressor and ensures system reliability. PAC unit should use environmentally friendly refrigerant R410A. PAC unit should be equipped with positive temperature coefficient (PTC) electrical heater used for heating during low temperature conditions to improve reliability. (Optional function) PAC evaporator should be equipped with a four-row inner-grooved copper pipe and blue hydrophilic aluminium fin to ease condensation water drainage and prevent water loss while improving heat exchange. The evaporator should be a 'V'-type design to provide better air distribution and prevent air pressure drop. Standard configuration of the PAC unit's return air side includes built-in temperature sensors and temperature and humidity sensor to measure the temperature more accurately and increase system reliability. To reduce the impact to the upper grid caused by start-up of the PAC unit, its start-up current should be lower than rated current. PAC unit should be configured with surge protection device to increase safety and reliability. No less than 6kV ability is recommended. PAC indoor unit should use high efficiency, energy-saving variable speed EC fans to reduce fan power consumption. The PAC should use an energy saving humidifier so that maximum humidification power consumption will be lower than 50W, with the third-party test report to proof that. (optional) (The report will be ready at TR6) The compressor and dry filter should use a threaded connection so there is no welding work during maintenance. The threaded connection can reduce maintenance difficulty and shorten troubleshooting. To reduce the risk of unit, break down, the unit should detect the refrigerant content automatically and generate charging prompt when the refrigerant is insufficient.	

	For down flow unit, in order to improve the fan efficiency, the fan should be installed under the raised floor. It should adopt flipped and sunk type installation of fan, shorten the installation and maintenance period.	
	PAC control system	
30.	Each PAC should have its own internally developed, advanced microprocessor controller. A PAC controller should use a 7-inch, true-colour LCD touch screen that features good human-machine interaction, with a vivid interface that includes innovative one-step interface switching; simple and flexible operation; and sufficient monitoring points. The screen can graphically display the running status of each PAC component. The PAC should have a large-capacity memory to store at least 1500 historical fault alarms. The PAC should have a large-capacity memory to store at least 1000 operation logs. The unit should have power detection functions (such as reversed phase, phase loss, overvoltage, under voltage, high frequency, and low frequency), as well as fault diagnosis, alarm recording, automatic protection, automatic recovery, and automatic restart functions. The PAC should have linkage and grouping control functions. At least 32 PACs can be controlled and managed in the same area in a unified manner. Each AC controller can serve as the main controller and implement the following control functions: •Automatic switchover to the backup unit: When a unit in the group is faulty, the backup unit will automatically go into operation, improving the reliability of the air conditioning system. •Polling: Scheduled switchover to the backup unit in order to balance the operation time of every unit and improve unit life. •Cascading: The number of air conditioners that run in a unit is automatically controlled based on the heat load in the equipment room. In this way, there is prompt response to requirements, hot spots are eliminated, and energy saving is achieved. •Prevention of competitive running: It prevents multiple air conditioners in the same equipment room from running in the opposite status (cooling/heating or humidifying/dehumidifying), in order to achieve energy savings.	

	Each PAC has an independent control system, monitor, heater, humidifier, and temperature/humidity sensor to ensure normal and highly precise running of each unit. With a dual power supply, the A and B power should have separate lightning protection components. (Optional function) The PAC supports flexible air supply and return control modes. The control mode can be flexibly switched based on on-site requirements. The PAC supports the intelligent pressure difference control mode. The fan rotation speed can be lowered under partial loads to save energy. The pressure difference control module should be installed inside the unit. The PAC's guide debugging function guides operators through the unit commissioning process. The unit's running data is collected and analysed automatically, which helps O&M personnel evaluate the status of key components and simplifies O&M. The PAC can self-diagnose malfunctions. When a fault occurs, the fault diagnosis function is enabled. It excludes irrelevant causes of faults and quickly guides O&M personnel through maintenance. This simplifies O&M and reduces troubleshooting time. The screen can display 30 days' worth of temperature and humidity curves in colour, making it easy for operations staff to check the status inside the Disaster Recovery Centre. The running status and alarm information of the outdoor unit can be detected on the indoor unit's screen, triggering light, and alarms. The alarm information can be uploaded to the management system to take care of the situation.	
	VRV/VRF COOLING SYSTEM	**Compliance YES/NO**
31.	The scope comprises supply, installation, testing commissioning of air-conditioning by VRV/ VRF/MRV system. The system to facilitate the operation & control of individual room. The system shall be able to cater the partial load which can be as low as 10% of the total load. Thereby the operation of indoor & outdoor units is minimized. The inverter-based scroll compressors/digital scroll compressor which has higher EER are employed in the VRV/VRF systems ensure trouble free operation. The drain point of each unit shall be connected to the common drain point. Proposed AC system will be microprocessor controlled inclusive of safety factor & gadgets.	

	Vendor should submit proper calculation for the proposed solutions considering the weather conditions of DRC site as per the latest ASHRAE guidelines**.**	
32.	The condensing units should provide cooling within ambient range of -5-degree C to 50-degree C DB & heating is the range of 0-degree C to 15-degree DB. The Outdoor unit should have a one DC inverter scroll compressor and one constant speed scroll compressor. The outdoor unit should have a D-Shape coil for better efficiency and TOP discharge DC current operated fan motor. All the indoor units to have a EEV built in system and nowhere the EEV to be placed outside separately. All expose pipe to be covered with race way or heavy-duty flexible pipe for protection. Special precaution to be taken while, installing of the drain piping. The contractor shall be responsible for any leakage / seepage due to poor installation of HVAC drain till the guarantee period. Drain point to be tested for 24 hours after blocking one end. Drain piping will be plugged at both ends by appropriate method after completing the drain test to avoid chocking due to foreign material.	
	DC INVERTER TECHNOLOGY	
33.	Inverters are used to vary the speed of motors and in this way, can be used to control the capacity of a compressor. For refrigeration users they can be an effective method of accurately matching compressor capacity to load requirement. A way of reducing compressor output is needed in almost every application. Without the means to run efficiently at low capacity, compressor cycling by switching on/off is most commonly used. This method introduces large fluctuations and high-power consumption due to heavily loaded heat exchangers. Multiple compressor solutions overcome this problem to some extent and stepping by means of cylinder unloading is used with piston compressors.	
	OUTDOOR UNIT WITH HEAT PUMP	
34.	The outdoor shall be factory assembled weather proof casing constructed from heavy gauge MS panels and coated with baked enamel finish of colour approved by architect. The unit should be completely factory wired tested with all necessary control.	
35.	All ODU shall have minimum 2 Scroll Compressors and be able to operate even in case one of the compressors is out of order.	

36.	It should also be provided with duty cycling for multiple Inverter/digital compressor switching starting sequence of multiple ODU. The ODU shall be modular in design and should be allowed for side-by-side installation the unit shall be provided with its microprocessor control panel. The ODU unit should have anti-corrosive point free steel plate for easy mounting of the unit. The ODU should be filled with low noise, aero-spiral design fan with grill for spiral discharge airflow to reduce pressure loss and should be fitted with DC fan motor to better efficiency. The unit should also be capable to deliver of adequate external static pressure. The condensing unit shall be designed to operate safely when connected to multiple fan coil units.	
37.	Noise level shall not be more than 60 dB (A) at normal operation measured horizontally 1 M away and 1.5 M above ground. Control wiring from ODU to IDU shall be contractor's scope.	
	COMPRESSOR:	
38.	The compressor shall be highly efficient hermetic scroll type and capable of inverter control. It shall change the speed in accordance to the variation in cooling load requirement or the refrigerant volume through loading or unloading.	
39.	All outdoor units shall have multiple steps of capacity control to meet load on fluctuation and indoor unit should have individual control. All parts of compressor shall be sufficiently lubricated stock. Forced lubrication may also be employed.	
40.	ODU heater to be provided in compressor casing.	
41.	The inverter shall be IGBT (insulated gate bipolar transistor) type for efficient and quiet operation.	
	HEAT EXCHANGER	
42.	The heat exchanger shall be constructed with copper tubes mechanically bonded to aluminium fins to form a cross fin coil.	
43.	The aluminium fins shall be treated with anti-corrosion resin film.	
44.	The unit should be with E- bypass / split type heat exchanger for good efficiency of condenser.	
45.	The unit shall be provided with necessary number of direct driven low noise level propeller type fan arranged for vertical/ horizontal discharge. Each fan shall have safety guard.	

	REFERIGERENT CIRCUIT	
46.	The refrigerant circuit shall have liquid and gas shut off valve or a solenoid valve at condenser end.	
47.	All necessary safety devices shall be provided to ensure the safety operation of the system.	
	INDOOR UNIT	
48.	The selection deals with supply installation testing commissioning of various types of indoor units confirming to general specifications. Each indoor unit has electronic expansion valve which senses the temperature based on variation of the load and conveys the same for the outdoor modules to respond accordingly. The indoor unit shall be selected as per the dehumidified CFM.	
49.	Indoor units shall be either ceiling mounted cassette type, or ceiling mounted duct able type or floor standing type or wall mounted type or other as specified in BOQ. Each unit shall have electronic control valve to control the refrigerant flow rate respond to load variations in the rooms.	
50.	The address of the indoor unit shall be set automatically in case of individual and group control	
51.	In case of centralized control, it shall be set by liquid crystals remote controller.	
52.	The fan shall be dual suction, aerodynamically designed turbo, multi-blade type, statically & dynamically balanced to ensure low noise and vibration free operation of the system. The fan shall be direct driven type, mounted directly on motor shaft having support from housing.	
53.	The cooling coil shall be made from seamless copper tubes and have continuous aluminium 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 coil shall be factory tested at 21 kg/sqm air pressures under water.	
54.	Unit shall have cleanable type filter fixed to an integrally moulded plastic frame. The filter shall be slide away type and neatly inserted.	
55.	Each unit shall be provided with electronic expansion valve for cooling and heating.	
56.	Each unit shall be with wireless LCD type remote controller. The controller shall be able to change the fan speed and angle of swing flap individually and changes in set temperature as per requirement.	

	REFERIGERENT	
57.	Refrigerant should be only R-410A.	
58.	The entire condensing unit & evaporative unit should be factory assembled and tested. The units should come with an initial charge of referred R-410A from the factory. Any additional required refrigerant shall be added at site free of cost & loss of refrigeration due to deflect in equipment or workmanship shall also be filled up free of cost during execution and guarantee period.	
	REFERIGERANT PIPING	
59.	All refrigerant piping for the air-conditioning system shall be constructed from soft seamless up to 19.1mm and hard drawn copper refrigerant pipes for above 19.1mm with copper fittings and silver soldered joints. The refrigerant piping arrangements shall be in accordance with good practices within the air conditioning industry, and are to include charging connections, suction line insulation and all other items normally forming part of proper refrigerant circuits.	
60.	All joints in copper piping shall be sweat joints using low temperature brazing and or silver solder. Before joining any copper pipe or fitting, 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.	
61.	After the refrigerant piping installation has been completed, the refrigerant piping shall be pressure tested using nitrogen at 32 Kg per sq.cm. Pressure shall be maintained in the system for 24 hours. The system shall then be evacuated to minimum vacuum if 700 mm Hg and held for 24 hours. The air-conditioning supplier shall be design sizes and erect proper interconnections of the complete refrigerant circuit.	
62.	The suction line pipe size and the liquid line pipe sizes shall be selected according to the manufacturers specified outside diameter. 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.	
	DRAIN PIPING	
63.	Shall be UPVC.	

64.	The IDU shall be connected to the drain pipe made of rigid heavy duty UPVC, density 10 KG/sqcm min 20 MM Dia meter. The pipe under floor should be 20 Kg/sqcm	
65.	The pipe shall be laid in proper slope for efficient draining of the condensate water.	
	PIPE INSULATION	
	Refrigerant pipe insulation:	
66.	The whole of the suction and liquid line including all fitting, valves and strainers bodies etc. shall be insulated with 19 MM/ 13 MM respectively thick class 'o' electrometric nitrile rubber sleeve as per BOQ.	
67.	The joint shall be properly sealed with R242 adhesive of polychloroprene to ensure proper bonding at the ends.	
68.	Insulation of cold lines shall be carried out with armaflex/K-flex insulation sheets and tubes of appropriate thickness so that condensation does not occur.	
	Drain pipe insulation	
69.	Drain pipe carrying condensate water shall be insulated with 3 MM thick Kinifoam.	
70.	The joint shall be properly sealed with R242 adhesive of polychloroprene to ensure proper bonding at the ends.	
71.	For proper drainage of condensate U-trap shall be provided in the drain piping (wherever required).	
72.	All pipe supports shall be of pre-fabricated and pre-painted slotted angle supports properly installed with clamps.	
RACK, PDU, ASSET TRACKING AND STATIC TRANSFER SYSTEM (STS)		
	IT racks, rack-based access control system, rPDU, asset tracking	
	IT Racks	
1.	**a.** The racks should be designed to provide a secure, managed environment for server and networking equipment.	
2.	**b.** The racks should be UL or Equivalent approved and comply with EIA-310 / EIA 310 E, REACH and RoHs.	
3.	**c.** Front and back doors should be perforated with min 70% or higher perforations.	
4.	**d.** Racks should have a provision for cable entry from the top and bottom.	

5.	**e.** The racks should be available with a vertical equipment mounting space of 42U and each U position should be marked with its numbering.	
6.	**f.** The vertical mounting rails should have two sets of EIA mounting holes perpendicular to the primary mounting holes to allow devices to be mounted in the side channel.	
7.	**g.** Both the front and rear doors should be designed with quick release hinges allowing for quick and easy detachment without the use of tools. The front door of unit should be reversible so that it may open from either side.	
8.	**h.** The front and rear doors should open a minimum of 140 degrees to allow easy access to the interior.	
9.	**i.** All enclosure panels and rack-mounted equipment should be inherently earthed or grounded directly to the frame.	
10.	**j.** The racks should have a minimum of IP 20 rating for protection against touch, ingress of foreign bodies, and ingress of water.	
11.	**k.** Front and rear rails should be fully depth adjustable.	
12.	**l.** The roof of the racks should be removable from the interior of the enclosure without tools and should have cable entry holes to allow up to 2000 cables or 60A PDU plugs.	
13.	**m.** Server racks should be of 600 mm wide and 1200 mm deep with caster wheels and levelling feet. Overall height of racks should not exceed 2000 mm including castor and wheels.	
14.	**n.** Network racks should be of 600 mm / 800 mm wide and 1200 mm deep with caster wheels and levelling feet. Overall height of racks should not exceed 2000 mm including castor and wheels.	
15.	**o.** All racks should be provided with toolless cable manager rings in rear side of the rack. Minimum 20 nos. of blanking panels to avoid air recirculation and bypass.	
16.	**p.** The frame shall support 1361kg static weight load, 1022kg dynamic (non- transit) weight load, and 907kg transit weight load.	
17.	**q.** All rack sheet metal components should be powder coated RAL7021 (Black).	
18.	The cabinet complies with IEC 60297-2 and is compatible with the 19" rack international standard**.**	

19.	The cabinet is made of high-intensity class A carbon cold rolled steel plates and zinc-coated steel plates.	
20.	The door frames of the cabinet can be installed with expansion bolts (ground) or bolts (base).	
21.	There are at least four mounting bars inside the cabinet for installing devices and securing partition panels. The distance between the front and rear mounting bars can be adjusted flexibly by each step of 25 mm. U numbers are marked.	
22.	The thickness of the non-load-bearing part of the cabinet is not less than 1.0 mm, the thickness of the load-bearing part is not less than 1.5 mm, the static bearing capacity is not less than 1500 kg, and the test report issued by a third-party authority is provided. The entire cabinet is protected to at least IP20.	
23.	All panels and accessories (except engineering installation supports) can be removed and assembled separately to ensure quick deployment and reduce labour costs. Dedicated cabinet connecting pieces are used. The connecting points are designed on the door frames of the cabinet. In this way, cabinets can be combined quickly without removing the cabinet doors. This saves labour costs and facilitates quick deployment.	
24.	The cabinet can be installed on a base, concrete floor, or ESD floor. The ground points of the cabinet are located at the lower or upper part of the posts to provide comprehensive grounding protection. The cabinet should provide a separate grounding point for the PDU to improve the grounding safety and reliability.	
25.	Cabinets can be installed side by side. The connecting pieces should be delivered with the cabinets. Side-by-side cabinets should be separated from each other by side panels. Fixing holes are reserved at the bottom of the cabinet to connect to the ground or base. Castors are available at the bottom of the cabinet for easy transportation.	
26.	Connecting parts such as cabinet materials, screws, and bolts should be stainless. The cabinet should be configured with matched screws and knots.	
27.	There are at least four mounting posts inside the cabinet for installing devices and securing partition panels. The posts can be adjusted forward and backward. The posts on the front door of the rack must be marked with U numbers. The cabinet posts should be made of eight-folded profiles by one-off roll forming. The thickness of steel plates used by the main load-bearing components (frame, beam,	

	post, U-shaped mounting bar, L-shaped bracket, and partition panel) of the cabinet is not less than 1.5 mm. The thickness of steel plates used by the side panel, top panel, bottom panel, PDU fixing panel, strong-current cable binding panel, network cable binding panel, and baffle panel is not less than 1 mm.	
28.	The load-bearing capacity of the L-shaped bracket of the server cabinet is not less than 50 kg. The load-bearing capacity of the adjustable tray is not less than 100 kg. Its depth can be adjusted in the range of 570 mm to 870 mm. It can be moved along the mounting bars and installed by one person. The load-bearing capacity of the fixed tray is not less than 100 kg, and its depth cannot be adjusted after installation. The effective bearing space inside the cabinet is at least 42 U (2000 mm high). Device trays of different specifications can be configured as required. The number of trays configured for each cabinet can be increased as required.	
29.	The effective installation depth of devices inside the cabinet is not less than 750 mm. The PDU or sockets (including the situation after the power plugs of servers are connected to the sockets) should not hinder the installation of servers. It is recommended that four reserved holes with rubber ferrules be designed for the frame structure on the top of the cabinet. The edges should be smoothed to avoid scratching cables. The cable inlet should be equipped with a cable fixing device and a dedicated sealing device to prevent air leakage. The bottom of the cabinet should be sealed.	
30.	There should be a depth of at least 50 mm between the mounting bars on the front posts of the cabinet and the front door frame, and at least 200 mm on the rear side of the cabinet. Removable baffle panels should be installed on both sides of the area. After all servers are installed, cold air can only be supplied into the servers through the air intake panel for servers. After heat exchange inside devices, heat is exhausted out of the rear of the cabinet and does not directly enter the hot aisle through other areas. Each cabinet can be configured with several 1 U and 2 U baffle panels. Buckle-type baffle panels should be used.	
31.	The cabinet should support overhead cabling, which facilitates future device expansion, cable management, and air circulation. The external and internal cabling of the cabinet should not affect the airflow organization and cooling effect.	
32.	A device for fixing cables should be installed at the side panel for routing weak-current cables. A device for fixing the vertical PDU should be installed at the side panel for routing strong-current cables, and a panel for routing strong-current cables should be configured.	

33.	After cabinets are combined, there should be no obvious gap through which light can penetrate between the cabinets. Grounding devices should be installed at the lower right corner of the front and rear doors of the cabinet. They should be close to the door frames and do not affect device installation. After a PDU is installed in the cabinet, the thickness should not exceed the plane on the same side. That is, there should be no blockage in the projection area of the net width between the rear planes of the cabinet.	
	Rack based access control system.	**Compliance YES/NO**
1.	**A.** The mechatronic access control system should provide an extensive range of alarms and system messages:	
2.	**a.** Unauthorized access	
3.	**b.** Status of lock(open/closed)	
4.	**c.** Green period	
5.	**d.** Blocking period	
6.	**e.** Temperature	
	B. The system should provide wide range of options:	
7.	**a.** Time stamp profiles	
8.	**b.** Days	
9.	**c.** Organizations	
10.	**d.** Temperature	
11.	**e.** Level of authentication-single, dual.	
12.	**C.** The solution should be capable for centralized architecture and decentralized architecture.	
13.	**D.** The mechatronic lock on both doors should be symmetrical and have an access provision from front door lock with two/three-point locking system.	
14.	**E.** All actions should be logged as “log events” which could be exported (pdf, html, mht, rich text, excel, icsv)	

15.	**F.** The mechatronic lock should have LED indication for status and field for display of rack name and number.	
16.	**G.** Four eye principle-dual authorization system via Biometrics.	
17.	**H.** The mechatronic lock should eliminate the use of traditional mechanical key lock for racks.	
18.	**I.** The mechatronic locks should be able to be retrofitted on server racks of different OEM rack manufacturers.	
19.	**J.** The mechatronic lock should have proper mechanism to override in case of network failure/power failure/ emergency without breaking the device.	
20.	**K.** The admin suite should facilitate planned access and super user function.	
21.	**L.** The admin suite should have task scheduler for pre-programming the activities in DRC.	
22.	**M.** The admin suite should allow specific user to be assigned to specific racks.	
23.	**N.** The admin suite integrates with authentication system like active directory, radius, etc.	
	Rack based IP PDU	**Compliance YES/NO**
1.	**a)** No. of output sets should be minimum **IEC 320 C13 x 18 and IEC 320 C19 x 6**	
2.	**b)** Input current rating: **230V, 1-ph, 32A or 400V, 3-ph as per requirement.**	
3.	**c)** The iPDU should have alternate phase & circuit interweaving to enable proper load balancing in case of 3 phase PDUs.	
4.	**d)** It should have billing grade +/-1% accurate metering of electrical parameters as per ANSI standards.	
5.	**e)** It should have min. 2 nos. of 100% rated low profile magnetic hydraulic circuit breaker for single phase iPDU and min 6 nos. in 3 phase PDUs.	
6.	**f)** It should conform to UL/CE or Equivalent, IEC Norms.	
7.	**g)** All plug types, input as well as **outlet** should confirm to best **industry standards** and should have **locking capability** to avoid accidental dislodging.	

8.	**h)** Locking capability should be Inbuilt to the sockets to make use of normal cables. In case, special power cords are required, it should be supplied by the bidder with PDUs.	
9.	**i)** Sockets should be preferably coloured to clearly identify different circuits.	
10.	**j)** It should support high operating temperature of 0 to 60 deg. C to take care of high operating temperature at back of rack.	
11.	**k)** It should provide following measurement parameters at socket level: current (A), voltage (V), real power (W), apparent power (VA), consumption (kWh) and power factor.	
12.	**l)** iPDU should have capability to daisy chain min 16 iPDUs to reduce use of number of network ports usage. During daisy chaining each PDU should retain its own IP address for easy identification and mapping and should maintain high availability over network.	
13.	**m)** The iPDU should have dual ethernet ports.	
14.	**n)** Provided solution should have capability for simultaneous commissioning, updating firmware, setting thresholds and alarms across multiple iPDUs using a centralized software.	
15.	**o)** Communication module in the rack PDU should be hot swappable.	
16.	**p)** The iPDU should support an android or iOS app for easy read of PDU recorded power readings. The connection should not use Bluetooth to prevent breach.	
17.	**q)** For security iPDU should support encryption via TLSv1.2	
18.	**r)** Should provide ease of integration into third party systems supporting an API.	
19.	**s)** It should be integrated with OEM's IT management software or DCIM.	
20.	**t)** It should have lowest power consumption about 10W on idle.	
21.	**u)** The communications protocols supported should include:	
22.	**v)** ARP, IPv4, IPv6, ICMP, ICMPv6, NDP, TCP, UDP, DNS, HTTP, HTTPS, SMTP, SMTPS, DHCP, SNMP (v1/v2c/v3), and Syslog.	
23.	**w)** It should have adjustable threshold values with an alarm function.	

24.	**x)** PDU should provide the capability of reporting error through **email** or any other method suitable.	
25.	**y)** iPDU should have capability to connect to 16 sensors (temperature, humidity, airflow, Dew Point).	
26.	**z)** It should have USB port for firmware upgrade and external log storage.	
27.	**PDU vendor should provide centralized software for bulk configuration.**	
SN	Technical specifications/requirements	**Compliance YES/NO**
	U level asset tracking	**Compliance YES/NO**
	NEA intends to implement state of art IT asset tracking to optimise and automate Disaster Recovery centre IT inventory tracking and audits. NEA has Identified rack U-level asset tracking as the most reliable way of achieving the said goal. With this, identification on an IT asset in a rack and U-level will be made easy, hence enhancing operational efficiency. Below are the specifications for same:	
1.	**a.** The RU-level asset tracking system should be able to automatically collect the information of IT assets and upload to a central software.	
2.	**b.** Should be able to locate the asset to which rack and which U.	
3.	**c.** Should be able to tell how many U heights are occupied by the asset.	
4.	**d.** Should have colour indicators to differentiate between:	
	a) Available U	
	b) Reserved U	
	c) Maintenance U	
	d) etc. to ease on-ground operations.	
5.	**e)** Should be able to automatically audit inventory of assets	
6.	**f)** Should be able to generate alert in following conditions:	
	a) Wrong placement of assets	
	b) Addition / removal of asset	

	c) Unauthorized move of asset alarm	
	d) Out of warranty alarm	
7.	**g.** It should provide tracking of when they are moved in/out of room.	
	Rack based static transfer switch,	
8.	**16A single phase for network racks with min 8 number of IEC C13 outlet, C20 input connector, remote monitoring capability.**	
	Intelligent cabling specifications:	
SN	**Technical specifications/requirements**	**Compliance YES/NO**
1.	OEM must be a member in the TIA and BICSI organization. OEM shall have RCDD certified manpower in Asia region for design support and validation. Certificate is mandatory.	
2.	OEM should have valid ISO 9001 and ISO 14001 certificate on design, development and manufacture of SW and HW solutions for communication networks.	
3.	The solution should be capable of tracking device history for networked end devices including the following forensics details:	
4.	When device was first connected to the network; If and when it was removed from the network; If and when it was moved from one physical location to another.	
5.	The solution should be a complete real time interconnect solution and should provide alerts for:	
6.	a. Patch cord connections or disconnections from the patch panel and switch.	
7.	b. Inter-changing of patch cords at the switch side and panel side.	
8.	The solution should be based on a designated IIM hardware which deliver physical connectivity information to the management software.	
9.	Device information - The software should provide information about the MAC id, IP and host name of the IP devices connected to the network.	
10.	Complete link information -The solution should automatically provide complete linkage information (from switch port upto the end device) in graphical format, providing full end-to-end visibility and automatic updates of new locations when moves occur.	

11.	Alerts on connectivity changes– The solution should report any changes on patching information in real time through physical verification only and not through any other method.	
12.	Real time view of communication racks–The solution should provide information of the rack layout in graphical view and allow interaction with displayed information in real time (e.g., lighting an LED over a panel port remotely). This is extremely important for remote site management.	
13.	Alerts – The solution should have in place the option to send alerts either through email, SMS, pop-up messages at client end and pop-up messages to dashboard.	
14.	Database-The database should be using an open database to enable easy integration.	
15.	Port status information-The solution should provide the capability of monitoring port availability status on network equipment including switches, patch panels and telecommunication outlets should be monitored in real time for the purpose of detecting unexpected or unauthorized activities.	
16.	Integration to 3rd party software- The solution should provide a comprehensive open-ended solution e.g., an SDK (software development Kit) and not just the capability to send SNMP traps to integrate the solution with any 3rd party software or in-house software like DCIM or NMS. The system shall be designed for hardware independence and operation in a network environment that facilitates interoperability and integration of third-party applications.	
17.	Dashboard: The solution should provide an inbuilt customizable dashboard to get information from the database and represent it for use in various formats. This is important so that all information from the database can be viewed without the need to interact directly with the total solution. This tool is essential for reporting all activities to higher management.	
18.	Rack indication: The solution should provide a special tool to easily identify the racks in which the two ends of the patch cord are connected in case the two ends are in two different racks, again without the need of any special query to database or reading from any special device.	
19.	Compliance: The solution should be complied with ISOIEC18598AIM and TIA TR421 and should comprise of following h/w to enable complete manageability.	
	Intelligent modular copper frames	

20.	1. The copper frame should support both cross connect and interconnect topology.	
21.	2. The copper frame should be a managed frame that supports up to 24 RJ-45 modular jacks.	
22.	3. The copper frame should have a single LED above each port.	
	Intelligent fibre trays	
23.	1. The fibre tray should support three types of fibre patching options: LC-LC, LC-MPO, and MPO-MPO.	
24.	2. The fibre tray should be a high-end fibre optics-managed tray that supports up to 96 LC-LC fibre strands in 1 U (LC-LC and LC-MPO) along with a full management system.	
	Scanning hardware	
	1. Each scanning hardware should support minimum 24 numbers copper or fibre panel ports (24 Ports).	
	2. The scanning hardware should support up to four TCP/IP ports through an internal L2switch, saving on ports in the main switch and enabling cascading of scanning hardware to provide unlimited network expansion.	
	3. The scanning hardware should support installation in zero-U configuration for rack space optimization. In case it is needed the device can be installed also in 1U configuration.	

Technical Specifications

Transformers

S.No.	Technical Details	Requirement	Compliance Yes/No
	Transformer	1500 kVA	
1	**Make**	To be specified by the bidder	
2	**Rating of Transformer**	As per data Centre load requirement and design	
3	**Voltage Ratio**	11/0.400 kV	

4	**Manufacturer**	To be specified by the bidder	
5	**Copies of IEC standards attached**	Required at the time of design approval	
6	**Copies of type test for rating attached**	Required at the time of design approval	
7	**Copies of design drawings attached**	Required at the time of design approval	
8	**Winding material:**	High Conductivity E.C Grade(A) Copper	
9	**Primary Winding BIL (kV)**	To be specified by the bidder	
10	**Primary Bushing BIL (kV)**	To be specified by the bidder	
11	**Design information**		
a)	Rated kVA (IEC rating), kVA	As per design	
b)	Number of phases	3	
c)	Frequency, Hz	50	
d)	Voltage ratio at no load, kV	11/ (400/230)	
e)	Winding connections	Dyn11	
f)	Type of core sheet	CRGO	
g)	Guaranteed No load loss at normal voltage ratio and 75^{o}C, Watt	To be specified by the bidder	
h)	Guaranteed Load loss at rated current and at 75^{o}C, Watt	To be specified by the bidder	
i)	Tap Changing Facility	To be specified by the bidder	
j)	Impedance voltage at 75^{o}C and rated power:	To be specified by the bidder	
k)	Temperature rises at rated kVA by thermometer in oil	To be specified by the bidder	
l)	Temperature rises at rated kVA by resistance of winding	To be specified by the bidder	
m)	Permissible overload	To be specified by the bidder	
n)	Transformer insulating oil specification	To be specified by the bidder	
o)	Total volume of insulating oil at 20^{o}C, litre	To be specified by the bidder	
p)	Insulation Class	To be specified by the bidder	

12	**Approximate weight and dimensions**		
a)	Weight of core, kg	To be specified by the bidder	
b)	Weight of winding, kg	To be specified by the bidder	
c)	Weight of tank and fittings, kg	To be specified by the bidder	
d)	Weight of Oil, kg	To be specified by the bidder	
e)	Total weight, kg	To be specified by the bidder	
13	**Radiator details**		
a)	No of radiators per transformer, no	To be specified by the bidder	
b)	No. of fins per radiator, no	To be specified by the bidder	
c)	Width of each fin, mm	To be specified by the bidder	
d)	Thickness of radiator, mm	To be specified by the bidder	
14	**Tank dimensions**		
a)	Length, mm	To be specified by the bidder	
b)	Breadth, mm	To be specified by the bidder	
c)	Height, mm	To be specified by the bidder	
d)	Tank sheet thickness (sides x bottom x top), mm	To be specified by the bidder	
15	**Approximate dimensions including fittings:**		
	Overall length, mm	To be specified by the bidder	
	Overall width, mm	To be specified by the bidder	
	Overall height, mm	To be specified by the bidder	
16	**Accessories listed below furnished?**		
a)	Lower oil filter valve	To be specified by the bidder	
b)	Liquid level gauge	To be specified by the bidder	
c)	Lifting lugs	To be specified by the bidder	
d)	Hand hole	To be specified by the bidder	
e)	Tank earthing terminal	To be specified by the bidder	
f)	Overload protection	To be specified by the bidder	
g)	If yes, details attached	To be specified by the bidder	
17	**Testing facilities available**		
a)	Applied voltage test	To be specified by the bidder	
b)	Induced voltage test	To be specified by the bidder	
c)	No load loss and excitation current test	To be specified by the bidder	
d)	Impedance voltage and load loss tests	To be specified by the bidder	

e)	Resistance measurement	To be specified by the bidder	
f)	Ratio tests	To be specified by the bidder	
g)	Polarity and phase relation tests	To be specified by the bidder	
h)	Leakage tests	To be specified by the bidder	
i)	Insulation resistance tests	To be specified by the bidder	
j)	Temperature rise test	To be specified by the bidder	
k)	Dielectric Type test	To be specified by the bidder	
l)	Tank pressure test	To be specified by the bidder	

Diesel Generators

S.No.	Technical Details	Requirement	Compliance Yes/No
	Diesel Generator		
1	**Make**	1500 kVA	
2	**Prime Rating at 0.8pf**	As per Design	
3	**Voltage**	400V	
4	**Frequency**	50Hz	
5	**Copies of standards attached**	Required at the time of design approval	
6	**Copies of type test for rating attached**	Required at the time of design approval	
7	**Copies of design drawings attached**	Required at the time of design approval	
8	**Approximate dimensions including fittings:**		
a)	Overall length, mm	To be specified by the bidder	
b)	Overall width, mm	To be specified by the bidder	
c)	Overall height, mm	To be specified by the bidder	
9	Approximate weight	To be specified by the bidder	
10	**Engine Specifications**		
a)	Engine model	To be specified by the bidder	
b)	Engine Power Rating	To be specified by the bidder	
b)	Displacement	To be specified by the bidder	



c)	Rated Output (prime rating as per ISO 3046)	To be specified by the bidder	
d)	No. of cylinder	To be specified by the bidder	
e)	Bore x stroke	To be specified by the bidder	
f)	Governing Class	To be specified by the bidder	
g)	Fuel Consumption		
	at 100% load	To be specified by the bidder	
	at 75% load	To be specified by the bidder	
	at 50% load	To be specified by the bidder	
	at 25% load	To be specified by the bidder	
h)	Lube oil Sump Capacity	To be specified by the bidder	
i)	Engine Coolant Capacity	To be specified by the bidder	
11	**Alternator Capacity**	To be specified by the bidder	
a)	Rating	To be specified by the bidder	
b)	Insulation Class	To be specified by the bidder	
c)	Ingress Protection	To be specified by the bidder	
d)	Time to build up rated voltage at rated RPM	To be specified by the bidder	
e)	Alternator Efficiency	To be specified by the bidder	
	at 100% load	To be specified by the bidder	
	at 75% load	To be specified by the bidder	
	at 50% load	To be specified by the bidder	
f)	Voltage Regulation	To be specified by the bidder	
g)	Permissible transient voltage dip at full load 0.8 pf lag	To be specified by the bidder	
13	**Others**		
a)	Air Inlet System	To be specified by the bidder	
b)	Control Panels	To be specified by the bidder	
c)	Cooling System	To be specified by the bidder	
d)	Exhaust System	To be specified by the bidder	
e)	Fuel System	To be specified by the bidder	
f)	Lube System	To be specified by the bidder	
g)	Mounting	To be specified by the bidder	
h)	Electrical Starting System	To be specified by the bidder	
i)	Battery Capacity	To be specified by the bidder	

j)	Noise Level	To be specified by the bidder	

RMU (RING MAIN UNIT)

S.No.	Technical Details	Requirement	Compliance Yes/No
	Ring Main Unit	(3-Way (CVV), 11KV, Gas (SF6) Insulated RMU with 1 Nos 630A load break switch and 2 Nos. 630 A SF6 Insulated VCB)	
1	Make	To be specified by the bidder	
2	Standard to which switchgears complied	IEC	
3	Whether RMU is type tested	Yes/No	
4	Type of Ring Main Unit	Metal Enclosed, Panel Type, Compact Module	
5	Ambient temperature	-5'C to 50'C	
6	Relative Humidity	max 100%	
7	Number of phases	3	
8	Rated Voltage	12kV	
9	Rated Frequency	50 Hz	
10	Rated current busbars	min. 630A or as per design	
11	Rated current VCB feeder	min. 630A or as per design	
12	Power Frequency Withstand Voltage	28kV	
13	Impulse Withstand Voltage	95kV	
14	Rated Short time current	21kA for 3 sec	
15	Rated short making current	>50A	
16	Insulating Gas	SF6	
17	Nominal operating gas pressure	1.4 bar at 20'C	
18	Gas leakage rate/annum	0.10%	
19	Expected operating time	30 years	
20	Whether facilities are provided for gas monitoring	Temperature compensated manometer to be delivered	

21	Material used in tank construction	Stainless steel, 3mm/metalized cast resin	
22	Means of switch operation	separate handle	
23	Means of circuit breaker operation	separate handle and push buttons	
24	Rated operating sequence of circuit breaker	O- 3min- CO- 3min-CO	
25	Total opening time of circuit breaker	appx 45ms	
26	Closing time of circuit breaker	appx 40ms	
27	Mechanical operations of switch	1000 CO	
28	Mechanical operations of circuit breaker	2000 CO	
29	Principle Switch/ earth switch	3 position combined switch/earth switch	
30	Degree of Protection		
a)	High voltage live parts, SF6/VCB tank	IP67	
b)	Front cover mechanism	IP2X	
c)	Cable covers	IP3X	
d)	Outdoor enclosure	IP54	
31	Colour		

5.3 Annexure – 3: Bill of material for Building civil work

Part A – MINIMUM BILL OF MATERIAL for Building civil work and conveyance system/IT infrastructure/DRC facility.

Part - A: Building construction area			
SN.	**Description**	**Unit**	**Qty**
Part -A	**Building construction area**		
1	Server farm area	Per Sqft.	1765
2	NOC area	Per Sqft.	265
3	Equipment area	Per Sqft.	200
4	BMS room area	Per Sqft.	210
5	Power room area	Per Sqft.	850
6	Meeting Room	Per Sqft	260
7	Cabin's area	Per Sqft.	220
8	Corridor area	Per Sqft.	190
9	Reception area	Per Sqft.	650
10	Rest rooms area	Per Sqft.	165
	Total	Per Sqft.	4775

Detailed BOQ of part A – DRC and other area for reference only. The price quoted shall include for whole infrastructure covering DRC, NOC and other office areas. Quantity may vary during detail engineering; such cost shall be included in the bid price.

The cost of the prefabricated container shall include all cost for material for container, internal and external finishing, illumination and all works related with the prefabricated container.

The bidders are also required to provide the costs for various components included in the DRC building container and infrastructure for DRC area as mentioned below. Please enclose separate detail sheet including cost of individual items.

Detailed BOQ of Part A – Building construction area (Indicative)

CIVIL AND INTERIOR PACKAGE			
SN.	**Description**		
1.0	**Container**: ISO 40ft (or as required) container, 12192mm * 2438mm / 3495mm*4150mm（D*W*H)		

CIVIL AND INTERIOR PACKAGE			
SN.	**Description**		
2.0	**Antistatic FLOORING:** Supply & fixing of 2 mm thick antistatic flooring with required accessories for UPS and battery rooms; DRC room, BMS room, staging area, storage room and ramp.		
3.0	**Carpet Flooring:** Providing and laying of std. carpet tile over NOC area, cabins, reception area. The floor which receives the carpet to be thoroughly cleaned as per manufacturer's specification. The carpet is to be laid over a bed of manufacturer's approved adhesive spread evenly over the entire floor. The rate shall include cutting, trimming, fixing and clearing away of residual material to a location as directed.		
4.0	**INSULATION**: Supply, installation, testing &commissioning of thermal insulation: Supply & fixing of thermal insulation above ceiling with 19mm thick XLPE/nitrile rubber on the DRC surface and under the roof of the entire area.		
5.0	**GYPSUM PARTITIONS:** 100mm GYPSUM board partition with two layer of 12.5 mm thick gypsum board on each side of the frame- screw fixed with drywall screws of 25mm & 35mm at 300mm Centres to either side of 48mm. Stud (0.5mm thick having one flange of 34mm and another flange of 36mm made of GI Steel) placed at 610mm c/c in 50mm floor and ceiling channel (0.5mm thick have equal flanges of 32mm made of GI steel) anchored to the floor & true ceiling using suitable anchor fasteners or metal screws with PVC plugs. The boards are to be fixed to the framework with joints staggered to avoid leakage through joints. Rate to include making provisions in panels, grooves and finishing the same to fix soft board (0.45x1.8m) and whiteboard (1.2mx3.2m) fixed flush on the partition. Note soft board and whiteboards will be paid for separately. Rate also to include making openings for glass panels, ducts, services and doors by providing concealed frames on all sides, framework above false ceiling and any other provisions reqd. to facilitate the same, all hardware etc. all complete.		
6.0	**GLASS PARTITIONS**: Supply, installation, testing & commissioning of 12 mm toughened glass on outer side and 10 mm clear fire rated glass on inner side in a 70x50x2mm SS 304 frame in suitable grooves. The gap between the two glasses to be 6 mm. This partition will be on one side wall of server farm area and staging room and BMS room.		

CIVIL AND INTERIOR PACKAGE			
SN.	**Description**		
7.0	**CEILING**: Supply &installation of grid false ceiling soft fibre acoustical suspended ceiling system with micro look edge tiles with 15mm exposed GRID. The tiles should have humidity resistance (RH) of 95%, NRC 0.9 - 1.0, light reflectance ≥85%, colour white, fire performance UK Class 0 / Class 1 (BS 476 pt. - 6 &7) in module size of 300 x 300 x 15mm, suitable for green building application, with recycled content of 43% (GW) The tile shall be laid on silhouette profile grid system with 15mm white flanges incorporating a 6mm central reveal in black colour and with a web height of 38mm and a load carrying capacity of minimum 11.25 Kgs/M2. Silhouette, main runners &cross tees to have mitred ends & "birds' mouth" notches to provide mitred cruciform junctions.		
8.0	**FIRE RATED DOORS** :Providing and fixing single or double steel door shutters with 45mm thick flush design shutter comprising of two outer sheets of 18 gauge steel sheets rigidly connected and reinforced inside with continuous vertical 20 gauge stiffeners, spot welded in position at not more than 150mm on Centres including void filled with mineral wool (density as per specification), all fittings, mortice lock with handle on both sides, tower bolt, stopper, aldrop, shop and final painting etc. all complete. Each door to have 300mm x 200mm vision panel fitted with wired fire rated glass.		
8.1	(1200mm + 300 mm) x 2400 mm unequal double leaf door	NOS	7
8.3	900 mm x 2400 mm single leaf door with panic bar	NOS	4
9.0	**WASHROOM DOORS (750mm x 1800mm)**	NOS	2
10.0	**Glass door:** Clear glass door of 10mm thick toughened glass with floor spring, handle, lock and top pivot to be installed in gypsum partition. The door to have "U" place at the top for fixing of electromagnetic door lock.		
10.1	900 mm x 2100 mm single leaf door	NOS	5
11.0	**Fire resistant paint -** 2 hrs fire rated paint of approved brand and shade to internal surfaces. The paint should be water based low voc & laid free. Conforming to green seal-11 voc requirements. (walls / partitions/ ceiling or any other location as directed), to give an even shade to the approval of the engineer, including thoroughly brushing the surface free from foreign matter, sand papering smooth, filling in all holes and cracks, applying lambi / patli and rubbing down the surface, lambi/patli sandwiched with two coats of approved		

CIVIL AND INTERIOR PACKAGE			
SN.	**Description**		
	primer, rate to include all tools, labour, scaffolding, primer as required completed as directed by the engineer.		
12.0	BLINDS: Venetian vertical collapsible blinds of appropriate colour for glazed walls.		
	FURNITURE		
13.0	Providing and fixing of 750mm high powder coated steel cabinets with shelves, locks, handles etc.	SQR MTR	5
14.0	P/F of fully upholstered chairs. Synchro tilt mechanism. Pneumatic height adjustable gas lift mechanism. Twin wheeled nylon 5 prong castors. Height adjustable arms with 360-degree rotation. Adjustable tilt tension with four stage back-lock. Adjustable backrest height. Sliding seat pan. Medium back / high back. Forward tilt. Soft arm caps. Foam density - 50 Kg/cu-m with hardness of 20Kg +/- 2 Kg at 25% compression. Fabric upholstered with fire retardant coating for fabric (Grade A - fabric)	NOS	15
15.0	Supply of three-seater sofa with fabric outer layout as per technical specification.	SET	1
16.0	Workstation running counter with 19 mm prelaminated board with smooth Surface and colour as approved by NEA and with drawer pedestal unit, wire manager in BMS, NOC area.	SET	3
17.0	Supply of glass top centre table mounted on teak wood polished frame.	SET	1
18.0	High back chair with armrest and comfort cushion.	NOS	2
19.0	Reception table as per specification.	NOS	1
20.0	File cabinet for cabins.	NOS	2
21.0	Manager table as per specification.	NOS	2
22.0	Modern dust bins with sensors.	NOS	10
23.0	Wall clock.	NOS	6
24.0	Printer table.	NOS	2
25.0	Shoe rack.	NOS	2
26.0	Hawaii slippers.	PAIR	25
27.0	Staging room table.	NOS	1
28.0	BMS room counter table.	SET	1
29.0	Signages.	NOS	10

CIVIL AND INTERIOR PACKAGE			
SN.	**Description**		
30.0	Housekeeping and other miscellaneous works.	LOT	1
31.0	ANY OTHER ITEM THE BIDDER MAY SUGGEST TO MAKE THE PCKAGE COMPLETE (PLS ADD BELOW)		
	Note: Quantities mentioned in the BoQ are tentative, bidder should include the required quantities to complete the work successfully without any additional cost to NEA.		

HVAC Package

<table>
<tr><td colspan="2">HVAC PACKAGE</td><td></td><td></td></tr>
<tr><td>SN.</td><td>Description</td><td>UOM</td><td>Qty</td></tr>
<tr><td>1</td><td>Required capacity of in-room air conditioner, including indoor unit, outdoor unit, supporting frame, copper pipe, and other accessories.
<table>
<tr><th>Sr. No.</th><th>SPACE</th><th>Area (sq. ft)</th><th>Minimum Require (cooling Capacity in Ton)</th></tr>
<tr><td>1</td><td>Server Farm Area (Rack room)</td><td>1765</td><td>24*</td></tr>
<tr><td>2</td><td>NOC Area</td><td>265</td><td>2.5*</td></tr>
<tr><td>3</td><td>Equipment Area</td><td>200</td><td>2*</td></tr>
<tr><td>4</td><td>BMS Room Area</td><td>210</td><td>2*</td></tr>
<tr><td>5</td><td>Power Room Area</td><td>850</td><td>12*</td></tr>
<tr><td>6</td><td>Meeting Room</td><td>260</td><td>2.5*</td></tr>
<tr><td>7</td><td>Cabin's Area</td><td>220</td><td>2*</td></tr>
<tr><td>8</td><td>Corridor Area</td><td>190</td><td>2*</td></tr>
<tr><td>9</td><td>Reception Area</td><td>650</td><td>3*</td></tr>
<tr><td>10</td><td>Rest Rooms Area</td><td>165</td><td>1.5*</td></tr>
</table>
* Note: Above values are minimum requirement, however the contractor has to submit the actual design for approval and consideration.</td><td>Lot</td><td>1</td></tr>
<tr><td>2</td><td>VRV/VRF air conditioning system, multi-connected, outdoor unit, required cooling capacity, power input 380V/50 Hz, DC variable frequency, Supply, installation, and commissioning of multi-connected indoor units.</td><td>Lot</td><td>1</td></tr>
<tr><td>3</td><td>VRV/VRF multi-connected indoor unit, required cooling capacity and required air volume.</td><td>Lot</td><td>1</td></tr>
</table>

<table>
<tr><th colspan="2">HVAC PACKAGE</th><th></th><th></th></tr>
<tr><th>SN.</th><th>Description</th><th>UOM</th><th>Qty</th></tr>
<tr><td>4</td><td>Ventilation system:
<table>
<tr><th>Sr. No.</th><th>Description</th><th>Area (Sqft.)</th><th>CMH (Cubic Meters per Hour)</th></tr>
<tr><td>1</td><td>NOC ROOM</td><td>265</td><td>710*</td></tr>
<tr><td>2</td><td>BMS ROOM</td><td>210</td><td>154*</td></tr>
<tr><td>3</td><td>CABIN-1 &2</td><td>220</td><td>63*</td></tr>
<tr><td>4</td><td>MEETING ROOM</td><td>260</td><td>223*</td></tr>
<tr><td>5</td><td>Reception room</td><td>650</td><td>223*</td></tr>
<tr><td>6</td><td>Equipment Area</td><td>200</td><td>223*</td></tr>
<tr><td>7</td><td>Rest Room area</td><td>165</td><td>146*</td></tr>
<tr><td>8</td><td>Server Farm Area</td><td>1765</td><td>1008*</td></tr>
<tr><td>9</td><td>Power Room</td><td>850</td><td>118*</td></tr>
<tr><td>10</td><td>Corridor Area</td><td>190</td><td>227*</td></tr>
</table>
* Note: Above CMH values are minimum requirement, however the contractor has to submit the actual design for approval and consideration.</td><td>Lot</td><td>1</td></tr>
</table>

Rack and containment Package

RACK containment PACKAGE			
SN.	**Description**	**UOM**	**Qty**
1	SITC of 42U Server Racks (600 mm x 1200 mm) UL approved/complied; The rack should be able to withstand a minimum static load of 1361 Kgs and rolling load of 1022 Kgs. The unit should have a minimum of IP 20 rating for protection against touch, ingress of foreign bodies, and ingress of water. Rack front door should have minimum 70 % of open perforation for efficient air flow. ROHS compliant. Racks should be supplied with access control system as per specification at both front and rear doors.	Nos	54
2	SITC of 42U Network Racks (800 mm x 1200 mm) UL approved/complied; The rack should be able to withstand a minimum static load of 1361 Kgs and rolling load of 1022 Kgs. The unit should have a minimum of IP 20 rating for protection against touch, ingress of foreign bodies, and ingress of water. Rack front door should have minimum 70 % of open perforation for efficient air flow. ROHS	Nos	6

RACK containment PACKAGE			
SN.	**Description**	**UOM**	**Qty**
	compliant. Racks should be supplied with access control system as per specification at both front and rear doors.		
	rPDU		
1	Rack Power Distribution Unit, monitor type-1PH-Full height vertical -free mounting plate.	Nos	90
	Aisle Containment		
1	Rack aisle containment, including two glass doors with access control system, plate, supporting beam and other accessory.	set.	6

Busbar Trunking System (BBT)

BUSBAR TRUNKING (BBT) SYSTEM			
SN.	**Description**	**UOM**	**Qty**
1	SITC of air insulated type copper busbar trunking system, with vertical & horizontal bends, with joints wherever required. BBT shall be with hitch support rods with adjustable height, supports shall be given at suitable intervals as required. Max. length of the rod shall be 1000mm. Bends shall not be measured separately; bends shall be considered as straight pieces & measured along the Centre line of BBT with 3 years comprehensive warranty and support.	Lot	1
2	Air insulated type copper UPS busbar trunking system (indoor), System voltage - 600 V & Insulation voltage of 1000V,250 Amps, 4pole, with neutral of 100% of phase conductor rating & externally mounted aluminium earth bus, short circuit rating of 25KAIC for 1 second, IP-2X, ARC FLASH certified with capability to place tap off boxes anywhere on the entire length without distance restrictions and colour coding for easy identification of connected power supply.	Lot	1
3	250 A end flange unit, TP+N, with neutral of 100% of phase conductor rating, with RYB indicating lamps & MCB, powder coated, with suitable busbar to terminate necessary cables as per SLD (with MCCB).	Lot	1
4	250 A End cap at the end of every BBT.	Lot	1
5	250A joint packs.	Lot	1
6	Hangers	Lot	1
7	3phase 32 A Tap-off box with 20 A, 10kA, FP MCB, 1 **No.** 32 A three phase, 4P+E, 5 pin industrial socket with plug top as per IEC standard.	Lot	1
8	1phase 32A Tap-off box with 32A, 10kA, DP MCB, **1Nos.** 32A single phase, 2P+E, 3 pin industrial socket with plug top as per IEC standard.	Lot	1
9	ANY OTHER ITEM THE BIDDER MAY SUGGEST TO MAKE THE PACKAGE COMPLETE (PLS ADD BELOW)		

Critical UPS (600 KVA, N+N, scalable to 900 KVA) & Non critical UPS (150 KVA, N+N) including Battery and Power distribution board package

UPS, Battery, and power distribution board package (Critical UPS)			
SN.	**Description**	**UOM**	**Qty**
1	**Power**: Supply, fixing and commissioning of required 600 KVA capacity (Scalable to 900 KVA) modular UPS (N+N) in high availability with dual electrical distribution cables and panels to racks. UPS to have hot swappable power modules and should be in minimum size of 50 KVA/50 KW power module capacities. The system shall comprise of continuous duty single bypass static switch module rated as per the frame capacity.	Nos	2
2	**Batteries cabinet**: The lithium battery or lead acid battery can provide 15 minut for full load operation system backup time.	Nos	4
3	**Power distribution board-MDB:** 1250A ATS input，1*630A/3P+1*630A/4P+3*160A/3P+3*63A/3P output	Nos	2
4	**Power distribution board-SMDB:** 630A input，5*250A/3P output	Nos	2

UPS, Battery, and power distribution board package (Non-critical UPS)			
SN.	**Description**	**UOM**	**Qty**
1	Modular UPS as per approved design of DRC 150KVA @ 0.9 pf for the non-critical load such as air-conditioning equipment, lighting, and other IBMS systems must have following features. The UPS must be in N+N (2N) configuration with 30 minutes back up on each UPS at full resistive load.	Nos	2
2	IGBT based UPS with high efficiency and power quality.		
3	**Output crest factor**: 3:1 without derating of output.		
4	**Output voltage distortion:** £ 5% for linear and non-linear loads;		

5	**Efficiency:** Overall efficiency of each UPS unit shall be greater than or equal to: 94% @ full load.		
6	Noise level: less than: 65 dbas.		
7	**Overload capacity:** The UPS shall be capable of supplying for at least:		
8	10 minutes @ 125% of the rated load;		
9	1 minutes @ 150% of the rated load;		
10	**Standards**		
11	IEC 62040-1 and EN 62040-1: UPS - safety.		
12	IEC 62040-2 and EN 62040-2: UPS - electromagnetic compatibility - [level C3 / C2 class A is optional].		
13	IEC 62040-3 and EN 62040-3: UPS - performance.		
14	CE marking.		

Safety, Security and Surveillance Package

SAFETY SECURITY AND SURVEILLANCE PACKAGE			
SN.	**Description**	**UOM**	**Qty**
	ADDRESABLE FIRE ALARM SYSTEM		
1	The fire alarm system includes the fire control panel, smoke detector, heat detector, fire alarm bell, and fire alarm horn strobe. The automatic fire extinguishing system uses the total flooding extinguishing mode and includes the fire control panel, manual emergency start/abort switch, gas extinguisher (including the fire cylinder, extinguishing agent, electromagnetic valve, pressure gauge, and pneumatic switch), fire control pipes (pipelines and high-pressure hose), nozzle, and gas release indicator.	Lot	1
	ASPIRATION SMOKE DETECTION SYSTEM		
1	Supply, installation, testing &commissioning, calculations of flow and hole sizes in pipe network. Sampling unit shall be of LED technology. Detected smoke density shall be able to be adjusted between high sensitivity to equal as ordinary smoke detector. Sampling system is connected to loop for ordinary fire alarm via address unit.	Nos.	1

	Operation of sampling unit and status shall be able to display in fire alarm central unit.		
	GAS BASED FIRE SUPPRESSION SYSTEM		
1	Seamless cylinder CCOE approved, complete with valve assembly and a pressure gauge with a safety burst disc and a safety cap with accessory.	Lot	4
2	Suppression gas	Kgs.	350
	ACCESS CONTROL SYSTEM		
1	Supply installation testing & commissioning of 4 reader main access controller microprocessor based, tamper protected wall-mount case and communicating on backnet/TCP/IP. ACCESS CONTROL SYSTEM which includes interface modules. For ICCC 2 doors, server room, dial 100 room and conference room with accessory.	Lot	1
	CCTV SYSTEM		
1	IP Indoor camera 5 MP Onvif Compliant, for complete facility surveillance inside and outside perimeter both.	Lot	1
	RODENT REPELLENT SYSTEM		
1	Master console panel including support bracket.	No.	1
2	SITC of transducer capable of emitting ultrasonic sound of frequencies 20 Khz and higher, with blinking LED indication & shall capable to covering area of 150 Sq ft. in floor & ceiling void and 300 Sq. ft. in room void. (The sound must be inaudible and non-disruptive to humans considering day and night timing of works)	No.	48
3	Rodent cable	Mtrs	350
4	25" PVC conduit including all accessories.	Mtrs	350
	WATER LEAK DETECTION SYSTEM		
1	Water Leak detection panel	Nos.	1
2	Water leak detection cable sensor	Mtrs	25
	BIRD REPELLENT SYSTEM		
1	Complete Package	Nos.	4
	DISASTER RECOVERY CENTRE INFRASTRUCTURE MONITORING SYSTEM (DCIM)		
1	DCIM system should be modular and support perpetual licensing which provides us flexibility to purchase and expand enhanced	Lot	1

	modules according to NEA future need. All requisite hardware's like servers should be supplied along with DCIM software.		

Passive N/W Cabling

PASSIVE N/W CABLING			
SN.	**Description**	**UOM**	**Qty**
1	Supply of pre-terminated cassette tray, 96F, LC-MPO, chassis w/o cassette as per specifications at RACK	Nos	50
2	Supply of pre-terminated HD cassette, 24, LC-MPO, MM-OM3, ceramic, rear 2*12 MTP connector and 12 LC duplex at front, as per specifications at RACK	Nos	50
3	Supply of pre-terminated trunk cable, MPO-MPO,12F, MM-OM3, ,35.0m as per specifications at RACK (polity and gender changeable) as per specifications.	Nos	50
4	Supply of pre-terminated trunk cable, MPO-MPO,12F, ITU-T G.657, MM-OM3, ,20.0m as per specifications at RACK	Nos	400
5	Supply of pre-terminated OM3 LC-LC 3-meter LSZH fiber patch cord FOR CASSETTE TO SWITCH CONNECTIVITY as per specifications at RACK	Nos	200
6	Supply of pre-terminated OM3 LC-LC 1meter LSZH fiber patch cord FOR CASSETTE TO SWITCH CONNECTIVITY as per specifications at RACK	Nos	200
7	Supply of 6 LC-MPO FAN-OUT cable 15 meter	Nos	50
8	Supply of pre-terminated OM3 LC-LC 15-meter LSZH fiber patch FOR patch rack to distribution rack switches	Nos	50
9	Supply of enclosure tray MPO cassette 96 core tray	Nos	50
10	Supply of LC-MPO cassette, OM3	Nos	100
11	Supply of patch cord, LC-LC, OM3, C/C, 1m	Nos	50
12	Supply of accessories fiber LC MM	Nos	50
13	Supply of card for MPO enclosure	Nos	100
14	Supply of UTP patch cord, 3.0m	Nos	100
15	24-port modular patch panel with faceplates in black, (1RU).	Nos	100
16	Jack, UTP	Nos	200
17	Cat6A, patch card U/UTP, C/C, 2m	Nos	100
18	UTP patch cord, 3.0m	Nos	100

PASSIVE N/W CABLING			
SN.	**Description**	**UOM**	**Qty**
19	Supply of copper cable, category 6A UTP, CM, 4-pair, conductors are 23 AWG, twisted in pairs, separated by an integrated pair divide surrounded by tape at rack.	Boxes	30
20	Supply of 12 port UTP patch panel as per specifications at RACK	Nos	50
21	Supply of cat 6a patch cord 3 meter as per specifications at RACK	Nos	200
22	Supply of cat 6a patch cord 1 meter as per specifications at RACK	Nos	200
23	Supply of 48 port cable manager as per specifications at RACK	Nos	50
24	ANY OTHER ITEM THE BIDDER MAY SUGGEST TO MAKE THE PACKAGE COMPLETE (PLS ADD BELOW)		

Diesel Generator Package

DIESEL GENERATOR PACKAGE			
SN.	**Description**	**UOM**	**Qty**
1	**Supply of required capacity for complete DRC and building SILENT DG, coupled to alternator mounted on a common base frame, complete with:**	Nos.	2
	(a) Batteries &leads.		
	(b) AVM pads.		
	(c) Residential silencer.		
	(d) First fill of lube oil.		
	(e) Acoustic enclosure.		
	(f) Manual control panel (Isolator).		
2	**Supply of adapter box with extended bus bar.**	Nos.	2
3	**EXHAUST SYSTEM**		
A	Supply of cladding for the residential silencers.	No.	2
4	**FUEL SYSTEM**		
A	Supply of 3000 Litres fuel tank.	Nos.	2
B	Supply of MS pipe 25 mm with bends, flanges packing as required.	Mtrs.	24
C	Supply of set of fuel pipe fittings like valves, tee, elbows etc.	Nos.	2

DIESEL GENERATOR PACKAGE			
SN.	**Description**	**UOM**	**Qty**
5	**LABOUR CHARGES**		
A	Labour charges for the above job at site including unloading, shifting & installing of DG set**.**	Job	2
B	Liasoning charges for approval from electrical inspectorate.	Job	2
C	Labour charges for PCC based foundation of DG set.	Nos.	2
D	BMS integration of DG set.	Nos.	1

Electrical works for DRC building

C	Electrical works: excluding the works specified in Part A		
C1.	**ILLUMINATION SYSTEM for DRC building**	Lot	1
C1.	**LUMINAIRES (FIXTURES)**		
	Accessories: screws, gripes, pvc tape, choke, starter, tube, bulbs, holder, flexible wi etc. all complete.		
1	Ceiling down light height efficiency circular LED down light heavy carrier with LED etc. all complete. Height efficiency circular LED down lighter.		
2	FTL mirror optic. surface/recessed mounting with electronic choke.		
C2	**FAN / EXHAUST FAN/AC**	Lot	1
	Accessories: knot, bolt, hook clamp, dimmer switch, flexible wire etc. all complete.		
1	Wall mounted split type air conditioning system.		
2	Exhaust fan or equivalent etc. all complete.		
C3	**SOCKET, SWITCH, JUNCTIONBOX (flush type)**	Lot	1
	Accessories: metal box, screws, gripes, flexible wire etc. all complete.		
	Dimmer for ceiling fan all complete.		
C4	**POINT WIRING / WIRES**	Lot	1
	Accessories; HDPE polythene pipe, screws, pvc tape, grips, circular box etc. all complete.		
C5	**EARTHING**	Lot	1

	ANY OTHER ITEM THE BIDDER MAY SUGGEST TO MAKE THE PACKAGE COMPLETE (PLS ADD BELOW)		

Water sprinkler system fire extinguishing system for DRC building & adjacent area.

3	Supply of ABC powder type portable fire extinguishers all complete as per below IEC standards: - IEC TS 62977-1, IEC TS 62977-2	Nos.	As requirement
	Water sprinkler system	Lot	1
	Fire alarm system	Lot	1
	Fire hose hydrant & cabinets	Lot	1
	ANY OTHER ITEM THE BIDDER MAY SUGGEST TO MAKE THE PACKAGE COMPLETE (PLS ADD BELOW)		

Lift for DRC building

4	2-ton capacity lift for equipment and personnel including lift platform		
	2-ton capacity lift 2 floors all complete	Set	1
	ANY OTHER ITEM THE BIDDER MAY SUGGEST TO MAKE THE PACKAGE COMPLETE (PLS ADD BELOW)		

Note: - The above-mentioned requirements are the minimum requirements. Any components or equipment not mentioned in the BOQ but required to run the complete solution will be provided by the bidder free of cost.

6. IT Cloud Infrastructure system

6.1 Network Topology Architecture

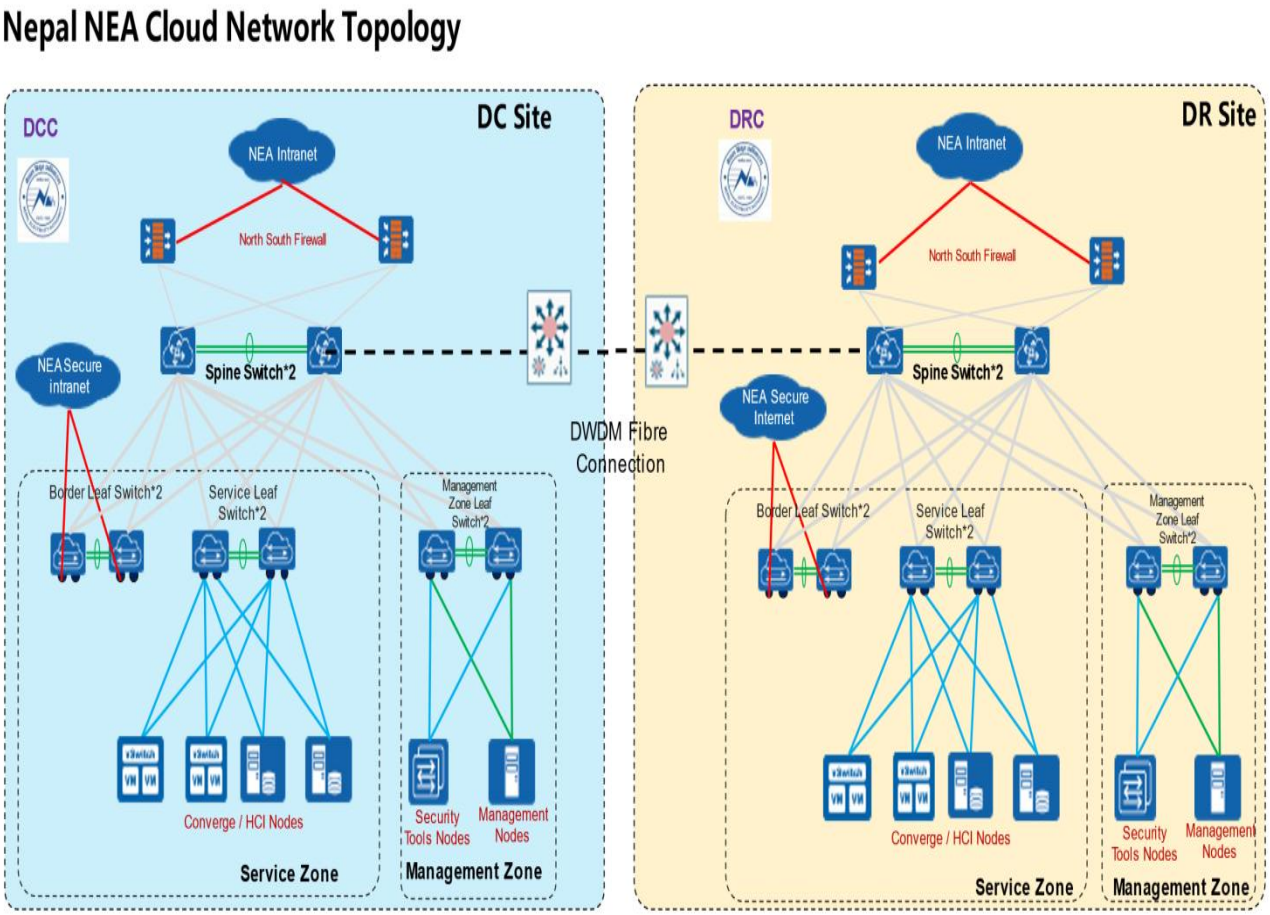


Fig: NEA Cloud Network Topology for DC-DR

6.2 IT Equipment: Technical Specifications

Bidders is responsible for implementation of the complete solution any item/solution which is not covered in BOQ but still require for desired performance, the same shall be included by the bidder in the bid form/commercial. No change request will be accepted in this regard.

The systems which are at a risk of technical obsolescence over the operating life of the system should be identified; this should include end-of-sale and end-of-support policies governing the proposed technologies. Forward and backward compatibility need to be considered, and mitigation option shall be indicated in detail and shall not be limited to periodic update from OEM/System supplier.

6.2.1 Private Cloud Infrastructure and Management

Private Cloud Infrastructure and Management		
S. N	**Product Names/Items**	**Description of requirements**
1	Brand	To be mentioned by the bidder
2	Model	To be mentioned by the bidder
3	Country of origin	To be mentioned by the bidder
4	Manufacturing Country	To be mentioned by the bidder
Technical Specifications for DC and DR Virtualization		
S. N	**Technical Requirements**	**Compliance (YES/NO)**
Hardware Specifications		
1	Proposed Infrastructure Solution should come with fully redundant field replaceable components.	
	Proposed Infrastructure Solution should have independent hot swappable components which can be replaced and serviced without having the need to power down.	
	Proposed Infrastructure Solution should include x86 Nodes of following specifications.	
	Proposed Infrastructure Solution should be fully compatible with the proposed Private Cloud solution	
Computing and RAM Pool		
2	**Total usable cores:**	

	For DC: Compute node (Minimum 1000 cores of Intel gold 4th Generation 2.1 GHz processor or above). At least 2x32 core Per node. **For DR:** Compute node (minimum 500 cores of Intel gold 4th Generation 2.1 GHz processor or above). At least 2x32 core Per node.	
	Total RAM: At least 16 GB per CPU Core, DDR5 4800 MHz	
	Proposed Infrastructure should have n+2 redundancy	
	Proposed Nodes should be populated 25G Network Interfaces and 1G Management interfaces.	
Storage Pool		
S. N	**Technical Requirements**	**Compliance (YES/NO)**
3	**Storage Pool Capacity:** **For DC:** At least 200TB Usable Capacity with NVMe SSD, at least 500 TB Usable Capacity with SAS SSD, at least 500 TB Usable Capacity with NL-SAS across All Private Cloud and at least 200 TB of NL-SAS should be reserved for backup. **For DR:** At least 200TB Usable Capacity with NVMe SSD, at least 500 TB Usable Capacity with SAS SSD, at least 500 TB Usable Capacity with NL-SAS across All Private Cloud and at least 200 TB of NL-SAS should be reserved for backup. Storage disks should be hot swappable and field replaceable The Contractor / System Integrator should provide backup capacity licenses for 200 TB.	
	The storage pool must support smoothly expand to 10 PB or above by simply adding additional disks in the same storage box or by adding storage nodes.	
	The solution should support Protocols: NFS, iSCSI & SMB	

	Proposed solution should have n+2 redundancy	
	Offered should support dynamic allocation of system resources to meet the performance of applications, and allow upper and lower limits on IOPS, bandwidth, or response latency to be set for specific applications to limit the performance of those applications.	
	Offered solution should support Synchronous /asynchronous data replication function to replicate data from the active data Centres site to the others site data centre.	
	Offered solution should support non-disruptive upgrades during the firmware upgrade.	
Power Supplies and Fans		
4	Redundant power supplies and Fans to be proposed.	
Minimum Network Interface		
S. N	**Technical Requirements**	**Compliance (YES/NO)**
5	Spine Switch (Qty: at least 2 for DC, at least 2 for DR): Provides at least 30 x 40/100G interfaces. At least 12 x 100G and 12 x 40G should be populated with multi-mode interfaces from day 1.	
	Leaf Switch (Type 1, Qty: at least 2 for DC, at least 2 for DR): Provides a least 48 x 10/25GE SFP+ and 4 x 40/100G interfaces. And at least 28 x 25G, 20 x 10G and 4 x 100G should be populated with multi-mode interfaces from day 1.	
	Leaf Switch (Type 2, Qty: at least 2 for DC, at least 2 for DR): Provides a least 48 x 1/10GE SFP and 4 x 40/100G interfaces, at least 20 x 10G SFP+ 10 x 10G copper, 10 x 1G SFP, 8 x 1G copper and 4 x 100G should be populated with multi-mode interfaces from day 1.	
	Leaf Switch (Type 3, Qty: at least 2 for DC, at least 2 for DR): Provides a least 48 x 1GE RJ45 and 4 x 10G	

	interfaces. And at least 4 x 10G should be populated with multi-mode interfaces from day 1.	
	The switch should support spine-leaf architecture/topology to optimize traffic flow and lower latency.	
	The switch should support IPV4 and IPV6 features.	
	The switch should support SDN (Software Defined Networking) features, can be integrated into mainstream SDN and compute platforms, and must support integration with Ansible, Open stack Neutron, or Open Programmability System (OPS) for future DCN fabric automation.	
	The switch should support PFC (Priority-based Flow Control), RDMA and RoCE	
Warranty and Maintenance		
S. N	**Technical Requirements**	**Compliance (YES/NO)**
6	The bidder should provide 3 Years comprehensive 24 x 7 x 365 Warranty for all equipment and software included in the proposed solution from the period of Go-Live.	
Private Cloud Vendor Qualifications		
S. N	**Technical Requirements**	**Compliance (YES/NO)**
7	Proposed cloud vendors should be a brand listed once or more than once in the Gartner's Magic Quadrant for at least last three (3) years or internationally equivalent for HCI or Cloud Infrastructure or Cloud services or Distributed Hybrid Infrastructure.	
Private Cloud Solution Requirements		
S. N	**Technical Requirements**	**Compliance (YES/NO)**
	The Private Cloud solution should include Hypervisor License.	

	Dashboard to manage and provision virtual machines, network, storage, monitor performance and manage events & alerts. It should also contain a dashboard for monitoring & generate reports. The solution should provide a log analytical tool which will show all the logs available in one single management console and a single location to collect, store, and analyse unstructured data from OS, apps, storage, network devices, etc. to make troubleshooting easier. Solution provider OEM should be able to provide the Virtualization software for Server.	
	Technology must be software defined and the solution should provide enterprise-class storage services.	
	The solution must be able to survive single node failures, and it should in no way affect/degrade the production services & usable resources to the end user application. Solution must support all the mentioned industry Leading protocols NFS, iSCSI & SMB.	
	Solution should include an infrastructure performance management tool quoted as part of the solution to improve operations and provide deep infrastructure performance insight.	
	It should be possible to use different storage policies in the storage LUNs/Container with Storage QoS	
	Solution should support live migration of running virtual machines from one physical node to another with zero downtime and continuous service availability. This feature should be applicable between DC and DR also.	
	The solution should provide enterprise data services such as de-duplication, encryption & compression without dependence on any proprietary hardware. The solution must be able to survive single node failures and it should in no way affect/degrade the production services & usable resources to the end user application. Solution must support all the mentioned industry	

	Leading protocols NFS, iSCSI & SMB. This should be delivered in both all flash as well as hybrid solution. These functionalities should be part of the proposed solution and licensed. The Proposed Private Cloud solution should support Erasure Coding for archival data storage.	
	The proposed solution must support connectivity to 3rd party bare metal servers (for optimized DB licensing on physical servers).	
	The proposed solution should support Hybrid and All Flash Nodes in the same cluster. Proposed SSD should be used for both storing Data and Caching. (If OEM uses SSD/NVMe dedicatedly for caching then additional SSD should be proposed). It should be possible to Pin IOPS hungry VMs on SSD only	
	Proposed solution should have inbuilt Data at Rest Encryption (DARE) and should also include Key Management Solution. (OEM should not depend upon 3rd party key management solution or specific hardware to achieve the same)	
	The solution should support to connect external storage devices (like NAS, SAN etc.) and should be useable as part of the Solution, for the purpose of Backup. There should not be any hardware vendor locking while connecting the external storage/s and this can be accessed over IP (No proprietary protocol should be used).	
Scalability and Evolution		
S. N	**Technical Requirements**	**Compliance (YES/NO)**
9	Proposed solution shall support unlimited nodes in a same cloud management platform	
	Data compression, deduplication, erasure coding techniques should be provided with licenses from day 1 in the Software Defined Storage (SDS) layer for use without any additional cost.	

	To ensure scalability of the cloud platform, the bidding cloud platform should support flexible scaling of PaaS services (such as micro-services, application middleware, and DevOps), big data services (such as Hadoop and data warehouse), AI services (such as natural language processing, video technology, and voice interaction), and IoT services can be unified maintenance and management.	
Data Protection		
S. N	**Requirements**	**Compliance (YES/NO)**
10	Ability to provide Replication of Virtual machine backup locally and in Disaster Recovery site. (VM level Mirroring) to protect selected VM's. If licensing module is there, bidder should provide licensing details. Should come with solution and should implement from Day 1 of operation.	
	Solution should be able to take App and database of VMs and containers consistent snapshot and should be able to schedule the same.	
	Shall be able to restore VMs and containers from the backup.	
Remote Replication		
S. N	**Technical Requirements**	**Compliance (YES/NO)**
11	Private Cloud solution should support file level recovery of user's data.	
	Private Cloud solution should support unlimited snapshot, it should not impact guest OS performance during snapshot.	
	Private Cloud solution should be able to take snapshot at any time irrespective of VM's state (Power ON/Power OFF/Suspended) with retention policy	

	Private Cloud solution should support crash consistent and application consistent VM backup within cluster.	
	Private Cloud solution must support two copies of data across cluster and should have capability for supporting three copies for critical data.	
	Private Cloud solution should support data replication across sites with customized RPO of 0 mins, 5 mins and 15 mins and grouping of Virtual Machines as per application architecture.	
	Private Cloud solution should support WAN Bandwidth optimizer along with defined schedule across two sites and only increment data should be replicated post one-time data sync.	
	Private Cloud solution should have license for three-way DR for active-active configuration on MetroCluster, near sync, async replication with defined RPO, some of VM's are working from Primary (Site-A) and their DR at DR sites (Site-B) and Some of the VM's are working from Site-B and their DR's is at Site-A. It should have feature to change VM IPs on the fly in case the DR site has different subnet from DC Site. The DR replication of the primary Data Centre does not affect host performance.	
	The Cloud Solution needs to facilitate cross-region Disaster Recovery (DR) for management components, allowing seamless transition of the management console between the production site and the DR site, as well as vice versa, through a one-click operation, while ensuring uninterrupted service availability.	
	The cloud platform provides cross-region DR solutions for IaaS, Container, middleware, databases, and big data to protect core service data and implement active/standby switchover upon a fault.	

	Both DR and backup support tenant services. Administrators can configure tenant quotas to manage DR resource usage.	
Hypervisor		
S. N	**Technical Requirements**	**Compliance (YES/NO)**
12	The solution shall provide a purpose-built hypervisor with minimal footprint that installs directly on the 64-bit bare metal x86 dual socket servers.	
	The Cloud Solution should enable users to request Windows or Linux based Bare Metal Servers via the management platform for running Oracle, MySQL, PostgreSQL, MongoDB or other services. Users can specify the flavour, image, network, security group, public IP, and login information when creating a BMS. The platform must support open standards, interoperability with multiple hypervisors, and allow the use of custom images, ensuring seamless migration and compatibility with other cloud providers.	
	Hypervisor should support container integration for cloud native application.	
	Virtualization Manager should have integrated Physical Host/ Node and Virtual Machine performance monitoring with high availability construct. No single point of failure for Virtualization Manager.	
	Single view of all virtual machines, allow Monitoring of system availability and performance and automated notifications with alerts. Monitor, analyse virtual machines, server utilization availability with detailed performance graphs and greater visibility into object relationships.	
	High Availability capabilities for the VMs in the sense if in case one server fails all the Virtual machines running on that server shall be able to migrate to another	

	physical server / node running same virtualization software.	
	Ability to thin provision disks to avoid allocating all storage space upfront. Full monitoring capabilities & alerts to prevent from accidentally running out of physical storage space should be there.	
	Hypervisor should support quickly reclaim storage space once the VM deleted.	
	Hypervisor should support OVA/OVF image import and export.	
	Hypervisor must have capability for OS Catalogue/template and OS provisioning with role-based access to virtual machine.	
	Capability for creating Virtual machine templates to provision new servers and also allow taking point in time snapshots of the virtual machines to be able to revert back to an older state if required.	
	Hypervisor should have integrated snapshot-based backup, schedule backup/restore and configure multiple copies of backup on periodic interval.	
	Proposed hypervisor should support standard features like non-disruptive migration of workload across hosts, High Availability and Distributed resource scheduling during resource constrain.	
	Hypervisor shall provide automated live migration for initial placement and balancing of available resources with the rules to define affinity and / or anti-affinity of workloads.	
	Hypervisor solution must allow seamless migration across different CPUs with Enhanced Compatibility mode per-VM during migrations across hosts in a cluster.	
	Hypervisor shall provide the ability to hot add CPU and memory, hot-plug disks and NICs (provided the same is supported by guest OS).	

	Hypervisor should provide ability to grant / ensure resources to virtual machines as they need for hosting critical workloads. Also, the initial placement of workloads should consider CPU, Memory and Storage contentions / hotspots.	
	Hypervisor shall provide zero downtime host patching with maintenance mode to move running workloads to other hosts on the platform with a consistent audit trail of the patching process.	
	Hypervisor should support UEFI bios along with legacy BIOS for supported virtual guests OS.	
	Virtualization Manager should automatically check cluster components, hosts, storage, network, hardware and cause of performance issue on configurable schedule with results on designated email.	
	Virtualization Manager should be able to identify out of the box top 10 VM's basis on their high resource utilization (CPU/Mem/Storage/Network) on single dashboard.	
	Virtualization Manager must support Directory based/Open LDAP and SAML based authorization for management.	
	Virtualization manager should keep at least 90 days historical performance data for VM's/Storage and partnering host.	
	Hypervisor/management must should be able to disable SSH based login to cluster for security and should have support for SSH key based login.	
	Hypervisor and Management must support SNMP version 3 and SMTP for proactive alerting and email configuration.	
	Hypervisor must provide centralized interface from which virtual machine access switching for the entire virtual datacentre can be configured, monitored and administered.	

	The Virtualization manager should provide a virtual switch which can span across a virtual datacentre and multiple hosts should be able to connect to it. This in turn will simplify and enhance virtual-machine networking in virtualized environments and enables those environments to use distributed virtual switches.	
	Virtualization Manager should provide feature which can perform quick, as-needed deployment of additional virtualized hosts. When the service is running, it can push out update images, eliminating patching and update without impacting production.	
	Solution should support change CPUs and memory capacity of Virtual Machine online without stopping services or restarting applicable.	
	Solution should allow users to create private images of VMs which can be used only by themselves or specific users.	
	Solution should support disk rate limiting using QoS policies. The I/O performance of a specified disk type can be limited, including the IOPS upper limit, bandwidth, and I/O priority, to prevent some services from pre emptying storage resources and ensure that the performance of all services is balanced.	
	Solution should support out-of-the-box block storage cloud service catalogues, and a self-service portal for tenants to apply for and provision storage service.	
	Hypervisor should support Rest API and Command line management along with GUI interface.	
	Required Hypervisor License and Hypervisor Management should be included into the solution.	
Container		
S. N	**Technical Requirements**	**Compliance (YES/NO)**
13	For the Cloud native application development requirement, the bidder should provide highly scalable,	

	high-performance, enterprise-class Kubernetes clusters and supports Docker containers.	
	The Cloud Solution Support container hybrid cluster deployment. Clusters can be deployed on VMs.	
	The container solution must facilitate graphical user interface (GUI) management of container nodes and multi-container clusters throughout their lifecycle. This includes functionalities such as cluster creation, hibernation, waking up, upgrading, and deletion.	
	The container solution should support the network interconnection between containers and hosts. the container network support layer-4 and layer-7 load balancing. Support container network security policies. Support basic data volume operations, such as creating, deleting, attaching, or detaching a data volume.	
	The container solution ought to enable automatic scaling of cluster nodes, responding to metrics like CPU and memory usage. It should also facilitate auto-scaling of cluster resources, following scheduled or periodic policies.	
	The Private cloud platform should offer graphical user interface (GUI) management for image lifecycle tasks, including uploading, downloading, and deleting images. Users can perform these actions either through the Docker client or by uploading images via the web page interface.	
Private cloud Management		
S. N	**Technical Requirements**	**Compliance (YES/NO)**
14	Private cloud solution should support automated and zero touch upgrades from single management pane/console for hardware/storage/hypervisor with no major impact on production.	
	Private cloud solution should provide all key operation management and performance management from a	

	single console for Hardware/Storage/Hypervisor and VM 's management using HTML 5 internet browser.	
	Private cloud solution management pane should support integrate with Active Directory /LDAP, Radius, RSA SecurID, Novell e-Directory.	
	Private cloud solution must support monitoring via SNMPv3 and email alerting via SMTP, with compatibility for integration into third-party monitoring and alerting tools, and adherence to open standards for seamless interoperability with various network management systems.	
	Private cloud solution should have analytics on capacity behaviour and should have capability of showing all under and over utilized VM's with their right sizing information after current VM's usages.	
	Private cloud solution should be capable of creating custom dashboard with reporting as per customer ease and requirements, solution should be able to scan/search objects with advanced search option for faster access to require information for troubleshooting.	
	Private cloud solution should have capability for finding object anomalies from standard behaviours and report this before major bottleneck for solution.	
	Private cloud solution should have codeless / low code automation native engine to create troubleshooting for alert and remediation as per policy.	
	Private cloud solution should have capability for managing multiple sites/clusters from one HTML5 based browser with single sign on.	
	Private cloud solution should support rest API for third party integration and customized workflow for automation using rest API.	
	Private cloud solution should have call home capability for remote log collection and proactive support for predictive failure hardware component.	

	Private Cloud solution should provide seamless upgrade for Firmware, Hypervisor, Storage OS, BIOS and other such functions which are required in the Private Cloud platform. The upgrade should be online and should not be done from one single pane of management.	
	Offered solution should have inbuilt analysis for VMs and should be able to give report of VM performance for minimum 90 days. It should be possible to view constraint and overprovisioned VM from single GUI, it should be possible to create Customized Dashboard as per requirement.	
Networking Service		
S. N	**Technical Requirements**	**Compliance (YES/NO)**
15	Solution should provide Virtual Network visibility with application-centric protection from network threats and automation of common networking operations.	
	Solution should be able to integrate with provided orchestration layer and cloud management platforms using programmable REST APIs/OpenFlow/Netconf to provide end to end automation of network and security services.	
	Solution should integrate with 3rd party physical network & security solutions (or their managers) from leading OEMs using programmable REST APIs/OpenFlow/Netconf/Device packages to provide integration with proposed Spine-Leaf switches and existing Perimeter devices (network & Security).	
	Solution should offer comprehensive flow assessment, analytics, security groups and firewall rules suggestion for the purpose of implementing micro level segmentation to achieve zero trust security within the datacentre.	
	Solution should provide micro segmentation (Restricted access between VMs in the same VLAN/ VXLAN as	

well as across VLANs/ VXLANs) using integration with proposed stateful virtual firewall.	
Solution should provide a single centralized dashboard for managing monitoring and provisioning of entire network & security infra inside Private Cloud Infrastructure cluster.	
Solution should provide creation of security groups and security policies/rules based on parameters like virtual machine name/OS type/IP addresses/Security Tags etc.	
Solution should provide granular control and governance across VM-to-VM traffic or VMs pre-defined Group/Department.	
Solution should Support for layer-2 VLAN for networking and integrated VM IP's Management capabilities.	
Solution must ensure that only permitted traffic between application tiers or other logical boundaries is allowed and protects against advanced threats propagating within the virtual environment.	
Solution must support virtualized network functions (eg. virtual firewalls, load balancers, threat detection, and application performance monitoring etc.), which can be easily enabled for all traffic, or deployed only for specific network traffic.	
Solution should integrate with L2/L3 network device with API call function for all required network configuration (L2/L3) with VM Life cycle.	
Solution should support VM's life cycle policy-based firewall rules for east west traffic across VM's through one management console without any third-party software.	
Solution should provide a single centralized dashboard for managing monitoring and provisioning of entire network & security infra.	

	Solution should have zero trust policy model for connected systems or hosts.	
	Should offer control and tracking of operational user activity to meet audit and compliance requirements.	
	Solution should respond faster to security incidents and breaches by automating remediation processes, such as quarantining suspicious applications by integration with leading security vendors.	
	Solution should provide the functionality to remove all the network & security policies assigned to an application/VM whenever that application is decommissioned.	
	Solution should integrate (send, receive events, alerts to & from) with existing Network and Security monitoring tools like Network Management System (NMS), SIEM etc.	
	Solution should integrate with SMTP for sending appropriate email related to different type of events/alerts for the cluster environment.	
	The Cloud Solution should support the security mechanism to ensure the north-south, east-west traffic security.	
	Solution should allow users to create and delete NAT gateway instances on the management platform. SNAT and DNAT rules can be configured for each NAT gateway instance.	
	Solution should support Cloud DNS to link a domain name with a personal IP address for cloud resources.	
Security		
S. N	**Technical Requirements**	**Compliance (YES/NO)**
16	The cloud platform should enable the setup of access control rules for groups or batches of cloud servers with identical security needs, streamlining the security setup process.	

	The cloud platform can establish inbound and outbound access control list rules linked to subnets to safeguard the security of cloud servers.	
	The cloud platform provides protection for both Internet and Intranet perimeters through real-time intrusion detection and prevention, global unified access control, antivirus functionality, comprehensive traffic analysis, log auditing, and tracing capabilities.	
	The platform must safeguard the webpage against tampering by monitoring website directories in real-time. It should also restore any tampered files or directories using backups to prevent important system website information from being compromised.	
	It should support detect and blocks ransomware based on statically/dynamically generated bait files or ransomware signatures.	
	The container host can support scan vulnerabilities and configuration information in the container image, and also have the mechanism to protect the container running security including container escape detection, ransomware, file modification, etc.	
	The cloud should provide a cohesive security management and control platform. This platform offers services for managing accounts, authorizations, authentications, and audits (4A) to centrally oversee cloud computing resources. Through a unified operations and maintenance (O&M) login portal, it facilitates centralized, streamlined, and secure management and auditing for various cloud resources, including cloud servers, databases, application systems, etc.	
Private Cloud Orchestrator		
S. N	**Technical Requirements**	**Compliance (YES/NO)**

	The solution should have catalogue of Private Cloud services, and should support self-service provisioning capabilities.	
	The solution should provide authentication, authorization and accounting (AAA) out of the box	
	The solution should have Life Cycle Management Workflows: Provisioning.	
	Central administrator must be able to manage/control the marketplace view for the tenants. Any authorised user must be able to deploy the application using the published VMs in his application marketplace.	
	The solution should provide capability of generating reports for usage & performance.	
17	Ability to integrate with industry standard authentication like AD, LDAP, and other open authentication protocols such as SAML and OAuth, ensuring compatibility with third-party identity providers and seamless interoperability across diverse platform.	
	The model should include at least three user levels for the Platform (Admin/User/Monitor).	
	The solution shall provide a single pane of glass for automated provisioning with model-based orchestration of compute, network, storage through a unified multi-tenant IT service catalogue.	
	The solution shall allow authorized administrators, developers or business users to request new IT services and manage specific cloud and IT resources, while ensuring compliance with business policies.	
	The solution must be able to provision VM's on ESXi, Hyper-V or KVM hypervisor etc.	
	The solution must allow restriction of vCPU, Memory and Disk resources to each project or group of users.	
	The solution must allow management of existing/already provisioned VMs and perform automation task.	

	The solution must provide full audit governance on who launch the platform, output log of each action and script used to run the action.	
	The solution must allow/support disk image of Windows, Windows Server, all variant of Linux.	
	The solution must allow single management console to view the capacity, performance of the infrastructure.	
	The solution must support HTML5.	
	The solution must provide a marketplace to allow user to consume the creation of infrastructure easily.	
	The designer can define the vCPU & memory for each virtual machine.	
	The software must be able to integrate with monitoring software.	
	The software must be able to integrate with application security vulnerabilities detection software.	
	The Software should have user management capabilities to support the following:	
	a) Highly configurable user role model.	
	b) Mass maintenance of a group of users.	
	The Software should support AD authentication, and synchronization of user list and profiles between Software and Active Directory setup.	
	Solution should support up to five organization levels to match customers' various structures. Independent resource access permissions and cloud service management permissions and approval process are configured for each organization.	
	Tenants have the option to configure quotas for various resources they utilize. These resources encompass VMs, images, storage disks, network ACLs, VPNs, and virtual load balancers.	
	The solution can do the metering and pricing, gathering data on tenants' resources usage and their associated costs. It should allow for customized pricing for various	

	services. Users will be able to access monthly, quarterly, and yearly reports to monitor departmental resource usage against budget allocations.	
	All cloud services feature unified alarms, logs, and permissions. They support URL dialling tests, enabling rapid fault localization for cloud services. This prevents issues such as the independent procurement of numerous ecosystem products, high integration complexity, lengthy time-to-market (TTM), multiple operations and maintenance (O&M) interfaces, and challenges in fault localization and demarcation across multiple vendors.	
	The solution must be able to support separation of account creation and role assignment.	
Firmware Code and Patch Management		
S. N	**Technical Requirements**	**Compliance (YES/NO)**
18	The solution should provide seamless upgrade for (but not limited to) Firmware, Hypervisor, Storage OS/SDS software, BIOS and other such functions which are required in the solution.	
	All patches for the complete hardware and software solution must come from a validated source. It should be possible to apply and upgrade all software and Hardware related firmware and patches from the GUI that is used to manage the Private Cloud (It should not use the hardware management console for doing firmware upgrade of hardware).	
Proactive Maintenance and Support		
S. N	**Technical Requirements**	**Compliance (YES/NO)**
19	Proposed Appliance should come with a single proactive incident reporting and alerting which covers both Hardware components and full Software stack.	

	Proactive Maintenance feature should automatically have the ability to alert all hardware and hypervisor related alerts to the 24 x 7 Call centre of the vendor.	
	Original Equipment manufacturer should have online 24 x 7 support for any hardware or software related issue and should have local support centre in Nepal.	
	Proposed solution should support maintenance for all the components including hardware, firmware and software used. The support should be from OEM / OEM Authorized Service Partners only.	SI/Contractor should submit the OEM Authorization letter of their OEM/ Authorized Service Partners
	Private Cloud solution must have direct OEM, L1, L2 and L3 support, 24x7x365 days with unlimited incident support (Telephonic/ Email) and technical contacts/contract with 60 mins or less response time including upgrades and updates.	

6.2.2 Endpoint Detection and Response (EDR)

S. N	Technical Requirements	Compliance (YES/NO)
1	The solution should have all its components deployed on premise (within Datacentre) and Solution should NOT share any data of endpoints i.e., telemetry details in public cloud.	
2	The solution should provide a unified web-based console for all functionalities and should allow administrators to access the management interface from any authorized machine, without installing additional software. Solution should provide Centralized auditing and logging of activity is maintained in the management console. Management activity must be logged and audited with the ability to send logs to an external source.	
3	Solution should provide Endpoint Protection (EPP) and Endpoint Detection & Response (EDR) capabilities available in a single agent without requiring multiple software packages to be installed and it must have all security features like Host firewall, Vulnerability Protection, threat-intel, Device Control, Application Control, DLP, real-time analysis & threat hunting.	

4	Solution should provide strong anti-tamper capabilities, to ensure that an end user can not remove, disable or modify the product in any way.	
5	Solution must support versions of Windows Operating Systems, which are currently supported by Microsoft (System Integrator/Contractor should provide at least 100 core processor licenses of windows server 2022 standard edition).	
6	The proposed solution should provide context-aware endpoint investigation and response (EDR), recording and detailed reporting of system-level activities to allow threat analysts to rapidly assess the nature and extent of an attack. The solution must have feature for Custom detection, intelligence, and controls.	
7	EDR Solution must have capability to protect the system against known and unknown malwares.	
8	Solution should be effective against sophisticated attacks by analysing Behaviours on an endpoint, along with signature-based approach and leverage AI or ML to analyse file pre-execution as well as analyse behaviours while a file is running. The solution should monitor and protect the system from lateral movements & insider threats, exploits and file less attacks.	
9	The proposed solution should be able to create multi-stage detailed kill-chain for performing the root cause analysis of an incident.	
10	The proposed solution should provide option to sweep and assess the current (point in time/Live) state of the devices like scan disk files.	
12	The proposed solution to provide the advance response capabilities as Mentioned below. 1. Kill process. 2. Isolate device.	
13	Tool to have the capability to control external USB media, Bluetooth Devices, and fine tune Block policy to allow only 'Read only' access to the USB media and apply device control policy to apply to a class, specific serial number or type of devices.	
14	The solution should provide Firewall Control for Windows. The firewall control policy should provide context unique to each group of Endpoints. IEEE OSI L4 Firewall and should support FQDN's, IP, CIDR, Range.	

15	The solution must Integrate with Active Directory for automatic Agent to Group Mappings and policy association. The solution management server should not have any dependencies on the AD state. The solution should have integrations with SIEM solutions such as Forti-SIEM (already implemented in NEA), Splunk & Qradar etc. EDR solution should natively send event logs via Syslog. The solution must support the following syslog formats: CEF/CEF2/RFC-5424. It should support SSL/ X.509 certificates for syslog transport encryption and authentication.	
16	Subscription must be valid for 5 years.	
17	Manufacture Authorisation to be submitted by bidder.	

6.2.3 Firewall

S. N	Technical Requirements	Compliance (YES/NO)
1	The Proposed Firewall Vendor should be in the Leaders'/Challengers Quadrant of Gartner Magic Quadrant or internationally equivalent for Enterprise Network Firewall for the last 5 years.	
2	The Proposed Firewall (NGFW) appliance/OS shall be EAL4 and ICSA certified.	
3	The equipment must have at least 2 x 100/40GE (QSFP28), 8 x 25/10GE (SFP28), 2x4OGE(QSFP+), 8x1OGE(SFP+) interface and 8 x 10G, 4 x 25G and 2 x 40G should be populated with multi-mode interfaces from day 1.	
4	The Firewall Throughput should be at least 120Gbps.	
5	Application controlling throughput (HTTP 100K) Minimum 50Gbps;	
6	Application controlling and IPS throughput (HTTP 100K) Minimum 30 Gbps.	
7	IPsec VPN throughput (AES-256+SHA256) minimum 40Gbps.	
8	Support SSL VPN Throughput minimum 10Gbit/s.	
9	Support Number of concurrent Sessions (HTTP) Minimum 20,000,000.	
10	Support Number of new Sessions (HTTP) per second minimum 1,000,000.	
11	Support at least 10 Virtual Firewall Instances.	
12	Support efficient and optimal data flow and provide dynamic application routing across multiple WAN links to optimize performance and enhance network reliability. Should have this option from day 1.	

6.2.4 Server load balancer (SLB)

S. N	Technical Requirements	Compliance (YES/NO)
1	The Load Balancer device should be a dedicated Hardware/Virtual Appliance (If vendor is providing virtual instance, then required cloud resources and infrastructure to be provided by the contractor without any additional cost to NEA throughout the complete project lifecycle).	
2	Should support multiple virtual network functions in which each VNF has a dedicated resources allotted to it like CPU, RAM, Hard Disk, SSL cores.	
3	The appliance shall deliver the high availability required by modern data centres. It should support Active/Passive or Active / Active HA configurations using standard VRRP protocol.	
4	The Load Balancer shall automatically synchronize configurations between the pair and automatically failover if any fault is detected with the primary unit.	
5	The solution should support upto 32 virtual instances. Should have internal redundant Power supply with min 4 TB usable hard disk, 64 GB RAM and capability to host other 3rd party and open-source virtual network functions like SSL VPN, web application firewall etc.	
6	The Load Balancer shall support offloading of SSL connections and should deliver 15 Gbps of SSL throughput on 2048 key.	
7	Proposed device should have minimum 1x1GbE port for management and 16x10GbE SFP+ ports.	
8	Proposed device should support upto 32 virtual instances with capability to run multiple virtual network functions like Linux-CentOS/ Ubuntu etc. in same appliance.	
9	The server load balancer should deliver minimum 3 million concurrent sessions.	
10	The server load balancer should cater up to 40,000 SSL transactions per second on 2K key RSA and upto 25K TPS (ECDSA-SHA256). Device should support minimum 2.5 million L7 RPS.	
11	Local Application Switching, Server load Balancing, HTTP, TCP Multiplexing, HTTP Pooling, HTTP Pipelining, Compression, Caching, TCP Optimization, Filter-based Load Balancing, Transparent Deployments, Content-based Load Balancing, Persistency, HTTP Content Modifications, Band Width Management (BWM), Support for	

	connection pooling to TCP request, Support for distributed denial-of-service (DDoS) protection.	
12	The solution should support XML-RPC for integration with 3rd party management and monitoring. Should also support SAA, SAML, Hardware binding and AAA support along with SSO. Solution must support machine authentication based on combination of HDD ID, CPU info and OS related parameters i.e., mac address to provide secure access to corporate resources on the same hardware.	
13	Should have secure access solutions for web-based system. mobile PDAs, Android, Windows and iOS based smart phones and tablets with machine authentication.	

6.2.4 Identity & Access management (IDAM)

S. N	Technical Requirements	Compliance (YES/NO)
1	Solution should support authorization, authentication, Administration & audit.	
2	Solution should support integration with 3rd party directory services like LDAP, AD etc.	
3	Solution should support single sign on-SAML2 & Open ID Connect.	
4	Solution should support self-service portal.	
4	Solution should give the flexibility to change the different themes and background.	
5	Solution should support authorised access to many applications AD, Google, Office365.	
6	Should support user & group's management.	
7	Solution should support REST API based integration with third party application.	
8	Solution should support RADIUS based authentication.	
9	Solution should support centralized access control.	
10	Solution should support flexible RBAC model.	
11	Solution should support flexible ABAC (Attribute access Control) model.	
12	Solution should provide the ability to make real-time course-grained authorization decisions such as a whether to grant access to an application	

13	Solution should allow access and authorization permission criteria to be linked to role definitions rather than to individual user accounts so that these decisions are driven by a user's membership of a role.	
14	Solution should support nested roles and the dynamic assignment of roles (based on user attributes).	
15	Solution should provide a mechanism to authorize users based on data sources outside the main solution identity data repository.	
16	Solution should allow for dynamic authorization rules (for example based on time, IP Address, etc).	
17	Solution should provide the configurable ability to restrict or allow concurrent logins by the same user.	
18	Solution should support time-based access controls (e.g. acquiring temporary access rights for admin).	
19	Central User Repository and Identity Management.	
20	Solution should provide the capability for a user to self-register (create an external user account) by providing some business-determined proof of identity to the solution.	
21	Solution should provide the capability for a user to self-register (activate their external user account) by implementing a configurable function that requires.	
22	Solution should provide creation (registration) of user accounts, according to configurable provisioning rules, triggered by an event in another application.	
23	Solution should support disablement/deletion of unused or expired accounts.	
24	Solution should provide role/rule-based facilities (registration based on user attribute-based customizable rules).	
25	Solution should support entitlement exclusions (e.g., separation of duties).	
26	Solution should support user defined entitlement types.	
27	Solution should support editors & viewers for the entitlement.	
28	Solution should support roles-based provisioning system.	
29	Solution should support automatically Load and Reconcile Account Data.	
30	Solution should support identify and eliminate orphan, dormant and ghost accounts.	

31	Solution should maintain summary of separation of users those who are transferred, retired or leave the organization.	
32	Solution should have user lifecycle management facility.	
33	Solution should give the option for the newly logged in user to change his password and the user shall be forced to change the password first time.	
34	Solution should provide option to authenticated user to change password.	
35	Password should be stored in encrypted format not in clear text.	
36	Solution shall provide Password expiry date and can also be set/modified as number of days after which the user status will be changed as "Password Expired". By default, the password expiry is enabled and set for specified day.	
37	Solution should be able to detect the failed login attempt for some specified number like 5, 10 times.	
38	Solution should support 2FA / MFA like SMS, EMAIL, DIGITAL CERTIFICATES, SOCIAL MEDIA LOGIN ETC.	
39	Solution should support integration with email gateway for publishing the important information on email.	
40	Solution should support auto generation password.	
41	Solution should have ability to define the challenge response for the forgot password.	
42	Solution should support self-service portal for the reset password.	
43	Solution should support encrypted password mechanism.	
44	Solution should support strong password techniques for the powerful login mechanism.	
45	Solution shall support users belonging to multiple groups.	
46	Solution should be able to connect to various applications on cloud with independent databases.	
47	The proposed solution should support Password less authentication mechanism.	
48	Solution should have the configurable ability to synchronize user account data with other authoritative data sources or repositories.	
49	Solution should be an event driven architecture which can make the changes as it happens in almost near real time.	

50	Solution should generate a unique user ID – a unique and permanent identifier to unambiguously identify every user in the solution identity data repository.	
52	Logging & Reporting.	
53	Solution should perform basic audit and logging capabilities.	
54	Solution should produce log data files in a format that can be viewed and manipulated using 3rd party reporting tools.	
55	Solution should provide operational and user activity reports provided out of the box.	
56	Solution should allow for the automatic archival of audit logs after a given period of time.	
57	Solution should support Event Based Logging. User ID that performed the event IP address from where this operation was performed. Resource that was requested.	
61	Role based audit log.	
62	Syslog based audit log.	
63	Syslog severity-based audit log.	
64	Type of operation performed.	
66	Workflows.	
67	Solution should support Self-service portal to create requests and approval	
68	Solution should support multi-step approvals.	
69	Solution from an OEM that is CMMi LEVEL 3. Certification copy for the same to be submitted along with bid.	
70	"The proposed solution must be an industry standard solution from an OEM that is ISO 20000, ISO 27001:2022, ISO 14001:2015, ISO 9001:2015 to ensure the quality and security. Certification copy for the same to be submitted along with bid".	
71	The proposed solution should be secured with single sign-on (SSO) and support authentication through LDAP.	
72	PAM and IDAM solution should be from Same OEM.	

6.2.5 Privilege access management (PAM5)

S. N	Technical Requirements	Compliance (YES/NO)

1	Solution should support privileged Session Protocols - Terminal Rdp, Vnc, Ssh, Telnet etc.	
2	Solution should support multitenant.	
3	Solution should support 4A protocols i.e. Authentication, auditing, accounting & authorization.	
4	Solution should support distributed deployment.	
5	Solution should support Unified Login and Authentication for resource; LDAP/AD authentication; RADIUS authentication; Single Sign-on (OpenID authentication, CAS authentication); SSO integration.	
6	Solution should support MFA.	
7	Solution should have Users, user groups, assets, nodes of assets, applications and system users can be authorization capability.	
8	Solution should be able to support different levels of organizational structure, assets and nodes of the structure can be flexibly authorized.	
10	Solution should support finer-grained application authorization;	
11	Solution should be able to control the commands executed by authorized system users; Authorized system users 'command execution is under control.	
12	Solution should support SFTP file upload/download and Web SFTP file management;	
13	Solution should support management of management user and system user;	
14	Solution should Support asset password managed service; Automatic generation of password; Automatic push of password; Password expiration setting;	
15	Solution should support for auditing the logs of users logging into the Jump Server system and collecting the audit information to Syslog;	
16	Solution should support user operation behaviour auditing;	
17	Solution should support online session content auditing and historical session content auditing;	
18	Solution Should support auditing recordings of asset operations (such as Linux and Windows machine) and application operations.	
19	Solution should be able to provide the capability of monitoring and interrupting the user's operation behaviour in real time to the administrator/auditor, so as to improve the security of user's operation.	

20	Solution should support auditing operation commands of asset and application and alerting to commands with high risks.	
21	Solution should support auditing the records of the file upload/download;	
22	IAM and PAM solution should be from the same OEM for the seamless working of the solution.	
23	PAM solution support native integration with SIEM tool for forwarding the security logs/events.	
24	PAM solution should have the following components:	
	1. Console.	
	2. Workbench.	
	3. Audit.	
25	The proposed solution should have option to create the ACL to give more granular level authorization.	
26	The proposed solution should have option to the live monitoring of the ongoing session.	
27	The proposed solution should have web terminal functionality.	
28	All the required modules should be from same OEM and pre integrated from day one.	
29	The proposed solution must be an industry standard.	
30	The proposed solution has strong password policy creation to ensure security of the system.	
31	The proposed solution should support bi-directional file transfer feature.	
32	Solution from an OEM that is CMMi LEVEL 3. Certification copy for the same to be submitted along with bid.	
33	"The proposed solution must be an industry standard solution from an OEM that is ISO 20000, ISO 27001, ISO 14001, ISO 9001 to ensure the quality and security. Certification copy for the same to be submitted along with bid."	
35	PAM and IDAM solution should be from Same OEM.	
36	The proposed solution should have deployment reference in Asian countries across Govts. / Enterprise/BFSI/ SDC etc.	

6.2.6 DNS Security

S. N	Technical Requirements	Compliance (YES/NO)
1	Each node uses a purpose-built, hardened operating system.	

2	Solution includes embedded, zero-administration database.	
3	The proposed solution must use a purpose-built, hardened operating system. No need for additional hardening or tunning of OS.	
4	If the appliance operates on a Linux-based system, the proposed solution should ensure that access via Linux system accounts is disabled or employ alternative methods to prevent exploitation of vulnerabilities arising from the OS libraries.	
5	The system integrates functionality and data from all services (DNS).	
6	Solution should have a central management application to manage DNS.	
7	The product has the option to propagate changes in real-time for immediate updates as well as scheduled updates.	
8	The Solution should support for the secure communication and centralized management and the product must use a standard encrypted protocol for communications between the devices.	
9	The central management solution should support automated push of config, database, software update, etc when one of the nodes in the architecture is replaced.	
10	The Solution should support the HA in both DC and DR with on-premises as well as Geo HA functionality.	
11	The solution should provide the HA for Reporting function with historical data retention without manually backup and restore.	
12	The product must be Common Criteria 2 certified EAL2.	
13	System shall support running on virtualization platforms such as Citrix, KVM, VMware, MS Hyper-V and OpenStack.	
15	The Solution must support 500 QPS acting as internal & recursive DNS Server at the same time Solution must allow for recursive only service. It should support 500 users from day one.	
16	The proposed solution must be based mandatorily on recursive, Authoritative, Caching, and AD-Integrated DNS Functionality.	
17	The proposed solution must support fault tolerant caching in case in case of authoritative service downtime.	
18	Solution must support the ability to specify a custom list of root name servers.	

20	The solution shall support termination of DNS over HTTPS and DNS over TLS on the DNS servers so the communication between client and offered DNS server can be encrypted for privacy.	
21	Product must support the ability to centrally manage, configure and report on compliance with RFC-based and customer-defined hostname checking policies (Strict, Allow Underscore, etc.).	
22	Product must support the ability to view DNS data in different ways (by zone, by server) in order to easily determine which data are served by each server, or to manage zones independently of name server.	
23	Solution must allow for recursive only service.	
24	Solution must allow for authoritative only service.	
25	Solution must support an advanced forwarder selection algorithm, such as choosing a forwarder according to roundtrip time.	
26	Solution must support diagnostic capabilities such as DNS query latency monitoring.	
27	Solution must support accepting dynamic DNS updates (DDNS) in real time.	
29	The DHCP solution should support DHCP-failover with the ability of handle 100 Lease/sec from day 1 and should have advance IPAM capabilities.	
30	Product must support the ability to centrally manage, configure and report on compliance with RFC-based and customer-defined hostname checking policies (Strict, Allow Underscore, etc.)RFC' s for DNS: 805, 811, 819, 881, 882, 883, 897, 920, 921, 073, 974, 1032, 1034, 1035, 1101, 1122, 1123, 1178, 1348, 1386, 1464, 1535, 1536, 1537, 1591, 1611, 1612, 1637, 1664, 1713, 1794, 1811, 1816, 1912, 1956, 1982, 1995, 1996, 2010, 2052, 2053, 2136, 2142, 2168, 2181, 2182, 2219, 2240, 2308, 2317, 2352, 2537, 2606, 2671, 2782, 2845, 2915, 3596, 3645, 3768, 4033, 4034, 4035, 4641, 4956, 4986, 5155, 5702, 5936, 6147.	
32	The management interface must be web-based with a multi-tenant architecture. It must allow to create different user profiles with different level of permissions. As an example, the roles must include:	
33	Administrator	
34	Reporting User	
35	Read-Only Users	

36	The policy editor must allow to forward the blocked connection to an internal URLs/Ips.	
37	The Solution should have security policy to prevent from DNS Based Fast attacks using Hold down feature, Recursive Query Timeout, fetches per server, Fetches per zone without any additional license.	
38	The management platform must have advanced reporting capabilities in order to determine which services are used inside the organization by traditional or embedded devices and eventually detect anomalies in their usage.	
39	All the activities made by administrators must be logged inside an Admin Audit Log Report.	
40	The DNS must have access to comprehensive logs also able to export the log in CSV format to any 3rd party reporting and analytics used by the operator.	
41	The Management console must provide real time reports on system Operation also must be able to create and maintain audit trails.	
43	The proposed solution must support several layers of security.	
44	The solution must provide signature-based security measures.	
45	The solution must provide reputational security measures.	
46	The solution must provide behavioural security measures.	
47	The minimum layers of security are:	
48	Advanced DNS Protection: Défense based on Signature and Volumetric DdoS.	
49	DNS Firewall	
50	DNS Analytics	
51	Ecosystem integration to integrate and automate with existing security infrastructure.	
52	The proposed solution must defend itself against volumetric attacks. Défense must not only cover the DNS protocol but also all other supporting protocols needed for DNS service delivery like NTP, BGP, OSPF, BFD, UDP, TCP, SNMP etc.	
53	The proposed solution has to provide updates to the security protection rules.	
54	The operator must be able to customize security rules.	
55	The proposed solution MUST support DNS Security features below:	

56	DOS	
57	DNS Exploits OS and application vulnerabilities	
58	Semantic attacks	
59	Reconnaissance	
60	DNS Amplification and Reflection Attacks	
61	Cache poisoning	
62	TCP SYN Flood Attacks	
63	UDP Flood Attack	
64	OSPF, BGP, BFD, NTP attacks	
65	Spoofed Source Address/LAND Attack	
66	Protocol anomalies	
67	NXDOMAIN Attack	
68	SERVFAIL Attack:	
69	DNS hijacking	
70	DNS Tunnelling	
71	DNS Malwares	
72	Random sub-domain (slow drip attacks), Domain look-up attacks.	
73	Phantom domain attacks.	
74	Solution Should have protection against malicious traffic distribution systems (TDS).	
75	Solution should support hybrid deployment option so that the authoritative DNS data remains within the organization and resolver data which is designed to go to internet can use cloud intel.	
76	Solution shall use technology to automatically update protection against new and evolving threats as they emerge to protect DNS service.	
77	You must implement a mechanism to protect the software DNS service malicious (malware) that exploits the DNS.	
78	Protection against malware must accept reputational domain information malicious.	
79	Automatic update of malicious domain reputation lists supported by the manufacturer.	
80	The control must validate: the domain, the IP address of the domain, the FQDN and IP address of the authoritative name server of the domain to analyse.	

81	The solution must be able to detect and block advanced malware related domains regardless of the specific ports or protocols used by the malware.	
82	The solution must be able to detect and block malicious domains using protocols different from HTTP/HTTPS.	
83	The solution must be able to block at least from the following categories of malicious domains: botnets, exploit kits, drive-by, phishing, newly seen domains.	
84	The solution must allow multiple security feeds, including 3rd party feeds.	
85	Security feeds must be provided feed with lowest false positive.	
86	Security feeds must be provided by centralize service with capacity to add additional feeds selected by the ISP.	
87	The vendor must have his own Threat Intelligence unit.	
88	The solution must support event logging in Common Event Format (CEF) format for integrating with SIEM solutions.	
89	It must be possible to integrate the DNS solution into the overall security ecosystem using web services.	
91	The solution has to synchronize and update from Internet, with centralize node.	
92	The solution has to provide a centralize distribution of Security feeds and threat intelligence to all nodes.	
93	The solutions must be able to deliver contextual awareness service and analysis to block threats from a dynamic set of high-risk IP addresses, to Detect malicious activities and sites and IP addresses.	
94	The solution must be able to prevent infections, blocking the DNS requests towards malware distribution domains or drive-by domains, and contain the pre-existing infections, blocking the DNS requests towards command-and-control infrastructures. The solution should support following Feeds: - • Base Hostnames • Anti-malware • Ransomware • Bogon • DHS_AIS_IP • DHS_AIS_ Hostname • DHS AIS NCCIC Watch list Hostnames and Domains	

	• DHS AIS NCCIC Watch list Ips	
95	DNS firewall and DNS malware prevention must work on all DNS query types such as A, AAAA, NS, SOA, MX, CNAME, ANY, PTR etc.	
96	OEM must have tool that security analysts can use to report on why domains were classified as malicious by the DNSFW/threat feed (Threat Lookup).	
97	The solution must leverage predictive intelligence and not just use static signatures or blocklists.	
98	DNS behaviour analytics engine shall use machine learning algorithms such as entropy, ngram, lexical size, frequency to detect anomalous patterns.	
99	The behaviour engine shall detect the DNS tunnelling and DNS exfiltration / infiltration automatically and once detected automatically apply policy using RPZ to block the communication.	
100	The DNS tunnelling and DNS exfiltration / infiltration must work on all DNS query types such as A, AAAA, NS, SOA, MX, CNAME, ANY, PTR etc.	
101	The threat intelligence must be automatically updated in less than 5-10 minutes after the discovery of a new threat without any manual update operations. The Threat Intelligence should be update as well as provided by same vendor.	
102	The vendor shall have an in-house threat research team to provide real-time intelligence and not depend on third party feeds or lists.	
103	The proposed solution shall be able to integrate with the sandbox solution on premise to provide correlated threat information and alerts.	
104	The proposed solution shall also protect users when they are outside of enterprise network and regardless of where they connect from, so far as they're using corporate asset to connect to internet.	
105	The proposed solution must support Threat Intelligence based on behavioural Analysis and Machine learning.	
106	· The Solution should have security policy to prevent from DNS Based Fast attacks using Hold down feature, Recursive Query Timeout, fetches per server, Fetches per zone without any additional license.	
108	SIEM - DNS event correlation.	

109	The Solution should provide the integration with Next Generation firewall for automated integration of security to block the user.	
110	The solution should provide the integration with for automated integration with NAC Solution.	
111	The solution should provide the integration with for automated integration with VAPT Solution.	
112	The Vendor must have TAC and Development centre in Asia region.	
114	The central management node (Master, not necessarily a dedicated unit for the function) must maintain continuous connectivity to all the managed nodes to retrieve also their operational status and keep synchronized all possibly relevant data in a real-time fashion.	
115	Each administrative change applied from the cluster management interface (GUI) must be possible to be scheduled for later activation and control.	
116	Software updates and patches must be applicable from the central management interface to all nodes of the cluster. Applying any update/patch must be possible without need to log into any of the cluster' s nodes and without need for root access anywhere. In no cases root access have to be allowed.	
117	An upgrade or patch must be possible without loss of configuration data during the process as standard procedure.	
118	The solution must allow to revert back from an upgrade and return to the previous operational configuration status (including old dataset) that was running prior to the upgrade, through a single command issued from the management interface (GUI).	
119	The graphical management interface (GUI) must include an automatic error prevention engine that controls all data being inserted via any of the interfaces available (GUI, CLI, API, etc) to prevent errors from being inserted in the configuration.	
120	The management interface must provide an administrator delegation function to control and limit access (Read-Only or Read-Write) only to the defined subsets of the whole dataset each administrator needs to operate on. All operations must be logged as for any administrator's activity.	
121	The access to the GUI on the Grid Master must be ruled by authentication mechanisms; user access rights can be governed through a local user	

	database or authentication can be provided through external systems such as MS Active Directory, Smart Card, Radius and Tacacs+.	
122	The solution must allow to easily import configuration data via integrated mechanisms in the GUI or via available importing tools.	
123	The solution must offer standard mechanisms to integrate with third party monitoring systems and alerting systems.	
124	To maximize security and audit, the solution does not have to allow root access to the underlying operating system or configuration layer for any reason.	
125	All management changes and controls must be possible from the centralized management interface (GUI) and from that all operational statuses of each node of the cluster must be visible and manageable.	
126	All communications between the Grid Master and the other Members of the cluster must be encrypted; all data transferred from the Master to the nodes has to be verified for correctness prior to being applied in the distributed database. This to guarantee data integrity against each configuration change.	
127	The GUI on the client must communicate with the management node only through secure communication channels (encrypted communication).	
128	Each administrator accessing the GUI must be authenticated and profiled prior accessing the dataset. Smart cards must be supported. Authentication shall be possible via authentication on a local user database or on MS Active Directory, RADIUS and TACACS+.	
130	Reporting must be delivered from a dedicated appliance so that resources to generate reports do not affect protocol delivery of DNS and other functions.	
131	All data needed to generate report must stay within the network. No data has to be exported to third parties in order to produce reports.	
132	The solution must come with rich reporting facilities.	
133	Reporting must be preconfigured with a rich set of reports.	
134	It must be possible to schedule automatic report generation and distribution by email or ftp.	
135	Reporting must have minimal impact on the DNS protocol delivery.	

136	Any change applied through the management interface, including the configuration changes to the services (DNS, etc) and the management changes to the operational status of the nodes (IP Address, management passwords, etc) must be propagated to all nodes in real time for immediate availability.	
137	DNS reports: - DNS top requested domain names, DNS replies trend, DNS cache hit rate trend, DNS query rate by query type, DNS response latency trend, DNS top clients per domain, DNS top nxdomain – no error, DNS top server fail errors sent/received, DNS domain query trend, top DNS clients by query type, top DNS clients querying mx records.	
138	DNS security reports: - DNS top rpz hits, top DNS firewall hits, malicious activity by client, DNS top tunnelling activity, DNS tunnelling traffic by category, top malware and DNS tunnelling events by client.	

6.2.7 Vulnerability assessment (VA)

S. N	Technical Requirements	Compliance (YES/NO)
1	Solution should have capabilities include unauthenticated and authenticated testing	
2	Solution should support various high-level and low-level internet and industrial protocols	
3	Solution should have capability for the automatic Scan	
4	Solution should give the flexibility to schedule the scanning process	
5	Solution should be able to manage the inventory list of connected devices	
6	Single instance of solution should be able to scan the 50000+ Ips	
7	Solution should have option to generate the compliance reports of the following option:	
	1. GDPR	
	2. HIPPA	
	3. ISO 27001	
8	Solution should have able to find the security vulnerabilities in any Internet facing system.	
9	Solution should be able to make the Alerts on detected change in scheduled report	
10	Solution should have custom scan options; Network/Server, Web, Word Press and Joomla Scans etc.	
11	Solution should provide a high level of user configurability	
12	Solution should be able to monitor the configuration of the connected device	
13	Solution should have option for perimeter scanning testing	
14	Solution should be able to perform the black box scanning	
15	Solution should be able to perform comprehensive security testing of an IP address	
16	Solution should be able to update the NVT's or vulnerability database daily	
17	Solution should be able to perform the Intelligence Scanning	
18	Solution should have option to User Management	
19	Solution should support concurrent scan task	
20	Solution should be able to give the CVE score against each vulnerability	
21	Solution should have option to categorize the Vulnerability as High, Low & Medium	

21	Solution should be able to deploy on Linux platform to reduce overall the TCO	

6.2.8 Data centres communication infrastructure specifications

Item	Sub-item	Minimum Requirement Description	Complying (Yes/No)
General Features	Technical Features	The bidder shall provide detailed technical descriptions and all features of the proposed equipment regarding system dimensions, bay-face drawing, power consumption, system characteristics, service channels schematic diagram, channel OSNR, electro-optical components, link budget calculation etc.	
	Language Support	The proposed equipment's management interface (console, remote login, Graphical User Interface, web interface etc.) shall all be in English language.	
	Modularity and Scalability	The proposed solution shall be modular and scalable.	
	Redundancy	Proposed DWDM equipment shall be redundant in DC and DR locations.	
	Fibre Core	Proposed DWDM network shall support dual core DWDM network including proposed Muxponder, by doing Link budget re-engineering.	
	Slot Capacity	Proposed Equipment should have 2*200G cards and the same should be populated with optical modules from day one.	
	Maintenance Responsibility (DCI)	In case of losses in some section/s occurred, bidder shall do all the necessary works with their manpower/fibre experts to improve the route losses until the losses reaches less than 30dB. If Fibre cable should be spliced less than 100m/point during maintenance shall be the responsibility of the bidder.	
	Support Required	The bidder shall provide complete support/technical assistance accounts for tele assistance and emergency support up to the warranty/AMC/FMS period.	
		The proposed equipment shall support simplified configuration. A single equipment shall support this configuration.	

	Hardware Architecture	All boards and system components (such as the system control board, optical module, power module, and fan module) of the proposed equipment should be pluggable and replaceable. If a component is damaged, the replacement of a single component should not affect other components.	
		The proposed device should have an LCD interface, which can display and set the IP address of the device, display alarm information, and facilitate operation and maintenance.	
		The proposed equipment in DC & DR must provide front-to-rear ventilation to dissipate heat.	
		The proposed equipment must support AC/DC/HVDC power supply.	
		Proposed equipment shall have redundant controller cards.	
		The resources such as CPU, memory in respective Cards, Modules, etc. shall be capable of handling the ultimate capacity with all the features enabled without deterioration in performance.	
	PS	Proposed equipment shall have redundant Power Supply.	
	LAN I/F	Proposed equipment shall be able to provide the external LAN interface for management.	
	N/W Support	Proposed DWDM network shall carry IP/MPLS network routers/L3 switches, PTN, Data Centre Interconnect.	
	Client I/F	Proposed client interface shall be SR 100G QSFP28.	
	Hot Swap	All interface cards, redundant control cards, power supply modules, fans in the offered equipment shall be hot swappable.	
	N/W Protection	Network protection shall be provided by routers in between source and destination traffic in the proposed solution. Network protection shall be done by DWDM system itself.	
	Service Slots	Proposed network should be designed in such manner that in future only Muxponders needs to be added in remaining sites by doing re link engineering. To comply this feature supplied chassis should have at least 2 service slots free from day 1.	
	Band Support	Amplifiers shall support full C- band spectrum 4800GHz and shall work on complete C-band from day one.	

System Monitoring	Performance Monitoring	Should support Performance Monitoring and Alarm as: Optical Channel Transport Unit Errored Second (OTU_ ES), Optical Channel Transport Unit Severely Errored Second (OTU_ SES), Optical Channel Data Unit Path Monitoring Background Block Error (ODU_PM_BBE), Optical Channel Data Unit Path Monitoring Errored Second (ODU_PM_ES), Optical Channel Data Unit Path Monitoring Severely Errored Second (ODU_PM_SES), Optical Channel Data Unit Path Monitoring Unavailable Second (ODU_PM_UAS).	
Electrical Layer	Access Service Type	The proposed equipment should support 8G~400G (FC1G/2G/4G/8G/12G/16G/32G,10GE/25GE/40GE/100GE/400GE) service access.	
		The proposed equipment should support SFP+ and should directly access 10G low-speed services to avoid failure risks caused by MPO mode fan-out access.	
	Line Side Capacity	The proposed equipment must support 100G/200G/400G/600G/800G single-wavelength transmission, and the wavelengths must be tuneable.	
Optical Layer	Optical System Capacity	The proposed equipment shall support one pair fibre capacity of min. 38 Tbit in C-band transmission and shall evolve to the C+L-band in the future.	
	Multi-dimension	The proposed equipment must support FOADM networking, manufacturer colour pages or product description certification materials must be provided.	
Reliability	Service Reliability	The Proposed equipment must support 1+1 service level protection, including but not limited to optical line, intra-board, and client-side.	
	Equipment Reliability	The Proposed equipment must support the system control board, power supply unit, and FAN unit, 1+1 protection for these all.	
	Data Security	To ensure network data security, Proposed equipment should support L1 AES-256 encryption, and the following conditions must be met.	
		The latency introduced by encryption shall not be higher than 1µs to avoid affecting actual applications.	

		Shall support channel-level configuration to meet the security level requirements of different services within the same wavelength.	
Operation & Maintenance	Service Activation Efficiency	The Proposed equipment shall support all-in-one integration of optical-layer boards (multiplexer/demultiplexer, OA, and optical supervisory channel) to reduce manual fiber connections.	
		The Proposed equipment shall support one-click automatic deployment, including fibre auto-discovery (intra-site/inter-site fibre connection discovery), wavelength auto-configuration, optical-layer auto-commissioning, and FC/ETH service autosensing.	
	Management Features	The management interface supports the CLI/Web GUI/SNMPv3/NETCONF/YANG/ NMS.	
	OSNR Features	The Proposed equipment should support built-in OSNR detection function and be able to monitor the optical power and OSNR of 100G/200G/400G signals online.	
	OTDR Features	The Proposed equipment should support built-in OTDR functions to monitor fibre faults online. The dynamic range shall be greater than 25 dB and supports bidirectional detection.	
	Latency Detection	The Proposed equipment shall support E2E service latency detection through the NMS. The NMS screenshot of the latency detection function must be provided.	
	Functional Diagram	The bidder shall submit functional block diagram of all main units of the offered systems indicating the function of each block along with the bid.	
	Manuals	Product Catalogue and Operation manuals shall be available on the website.	
Network Management System	Server and SW	Server HW with NMS SW needs to be provided along the proposed DWDM solution.	
	Resource Usages	The role of the NMS is to control and manage all possible scenarios such as Fault, Configuration, Accounting, Performance, and Security (FCAPS) to ensure maximum usage of the device's resources.	

	Flexibility	The NMS should be flexible and modular. The NMS should be flexible enough that it can implemented from a single machine to powerful open client server architecture in different platforms like Linux, Solaris, etc.	
	Inventory Management	The NMS shall support the inventory management to discover all the elements and their subsystem NMS etc. along with their part serial number. Inventory Management has to cover all the parts including chassis. The details obtain shall be and not limited to serial number, hardware version, software version, any resource if available like memory capacity, type of the inventory, description of the inventory, part code etc.	
	GUI	The NMS should provide a single GUI for configuration of all devices.	
	Configuration	The NMS shall support discrete configuration of the network elements.	
	FCAPS Functions	The NMS shall support the FCAPS functionality for all the network elements (NEs) being supplied by the vendor in this tender. The bidder shall provide NMS, detailed in the next sections, with fault, configuration, accounting, performance and security (FCAPS) functionalities; that can configure the system, manage faults and inventory of the whole system.	
	Views	The NMS should provide a chassis view / device view of all the devices. The device view shall be with all interconnectivities of the devices monitored by the NMS.	
	Accessibility	NMS shall be able to restrict access of views to certain users and groups to minimize the risk of data distortion.	
	Reports	All reports generated in NMS shall have the facility to be stored in local machine of the user exported in various standard formats as required.	
	Connectivity	NMS for the offered equipment shall be equipped with Northbound Interface to connect to higher level NOC/OSS.	
DCI System Management		The Fault Management Module shall have a flexible and scalable platform.	
	Fault Management	The Fault Management Module shall be able to set rules for alarm filtering.	

		All alarm/event messages shall be automatically time and date-stamped by the Fault Management Module.	
	Alarms/Events	All alarm related information (e.g. alarm receive-time start-time, clear-time, acknowledge-time, severity, probable cause managed device which originated the trap, descriptive name of the link etc.) shall be logged.	
	Configuration Management	The Configuration Management Module should provide a single GUI for configuration management.	
	Security Management	The Security Management Module shall be capable of login authentication to restrict / enable access to the manager.	
Industry Standard Certifications	SAN Certification	The Proposed equipment shall acquire the SAN certificate issued by DELL/NetApp/Hitachi/EANTC or other equivalent international organizations.	
	CC Certification	The Proposed equipment should acquire the CC certificate issued by FIPS/NSCIB/BSI or equivalent.	

6.3 IT cloud equipment: - Bill of material

Item No.	Item description	Minimum Quantity		
		Unit	DC	DRC
I	**(Hardware + Software) Cost at Data Centre and Disaster Recovery Centre**			
1	**Software License - IT Component**			
a	Private Cloud Orchestrator Solution	Set	1	1
b	Virtualization Software	Set	1	1
2	**Software License - Basic**			
a	Server OS License (For all the proposed virtual Machines- Windows and Linux)	Set	1	1
Sub-total Software License – Applications				
II	**Hardware/ Equipment**			
1	**Server Hardware**			
a	Compute Nodes **DC**- (Total usable cores - 1008 Cores) **DRC**- (Total usable cores - 504 Cores)	Set	1	1

b	Server Load balancer	Set	2	2
2	**Storage & Backup System**			
a	Enterprise storage (1024 TB)	Set	1	1
3	**Switches**			
a	Management Switch	No.	2	2
b	Spine Switches	No.	2	2
c	Leaf Switches Type -1	No.	2	2
d	Leaf Switches Type -2	No.	2	2
e	Leaf Switches Type -3	No.	2	2
4	**Security Solutions**			
a	Firewall	No.	2	2
b	EDR for Servers (For windows + Linux)	No.	100	50
c	Identity and access management with SSO for users	No.	500	0
d	Privilege access management solution for users	No.	50	0
e	DNS Security Solutions	No.	1	1
f	Vulnerability assessment and detection response (for 300 IP devices)	No.	1	
5	**Cabling System**			
a	CAT6 Cable, Patch cord, Jacks etc.	Lot.	1	1
b	Fibre Optical Cable, Connectors, Patch Cord etc.	Lot.	1	1
6	**DC-DRC Optical Connectivity Solutions**			
a	DWDM with multiplexer and demultiplexer (Complete solution)	Set	4	
b	Communication cards	Set	4	
c	Communication ports	Set	4	
d	Fibre Optical Cable maintenance during installation and O&M period as require (included supply upto 100 Mtrs patch only), Connectors, Patch Cord etc.	Lot.	1	
7	**Display and Work-Station**			
a	NOC Room: UHD (3840 x 2160) LED Display of minimum 75” Diagonal with complete with wall mount stand, management software and workstation	Set		1

b	BMS Room: UHD (3840 x 2160) LED Display of minimum 75" Diagonal with complete with wall mount stand, management software and workstation	Set		1

Note: - i) NEA will provide fibre cable but excluding accessories, tools and equipment, manpower, splicing, transportation and any other services. The cost shall be borne by the Vendor / Contractor for maintenance / replacement. But during implementation time any fibre cable required for DC-DR connectivity shall be provided by the contractor.

ii) The above-mentioned requirements are the minimum requirements. Any components or equipment not listed in the BOQ but required for the complete solution will be provided by the bidder at no additional cost.

Annexure –IV (Project Specific Environmental Management Plan EMP)

Table 1: Design Phase EMP

Topic	Activity / Issue	Commitment	Applicable Project Standards / Guidelines	Implementation Responsibility (Budget Source and Timing)	Monitoring Responsibility
Finalization of IEE	DC Gaps in baseline information and consultation required to inform detailed design	• Updating of the receptor inventory with results reflected in the updated IEE • Further meaningful consultations will be conducted as per the IEE	• ADB SPS (2009)	NEA NEA Counterpart Funds Before issue of bidding documents	NEA PMU / PISC
Siting and design of Project infrastructure	All Components Detailed design	• Design and layouts to reflect the requirements of the EMP and international engineering best practices/good EHS practice, as well as the issues raised by the public and other stakeholders as documented in the consultation chapter of the IEE report • Comply with all applicable national and state environment, health, and safety (EHS) regulatory requirements in addition to the mitigation measures set out in the EMP – if there is any conflict between national requirements and measures set out in the EMP the most stringent provisions will take precedence For all construction works undertake facilitated H&S risk assessment through a workshop during the design (and at other key stages) so it can inform both design and pre-construction preparations, considering both occupational and community H&S risks resulting from subsequent stages of the project. Facilitated workshop will involve the design and construction team of the contractors and NEA operational staff.	• ADB SPS (2009) • IFC EHS General Guidelines • IFC EHS Electric Power T&D Guidelines • ILO Worker Accommodation[1] • GoN laws and regulations (Chapter 2 of IEE)	EPC Contractor Include in EPC contract cost Before design approval for further implementation during construction phase	NEA PMU / PISC

Topic	Activity / Issue	Commitment	Applicable Project Stan Guidelines	Implementation Responsibility (Budget Source and Timing)	Monitoring Responsibility
	SS, DC and DRC Finalization of substation design and layout	• Design to minimize visual impact and clutter. Buildings will be designed in keeping with the existing substation buildings and/or local vernacular, albeit structurally sound etc. • Utilize landscape screening to screen the boundary wall and fences; these will need to be set back from the actual boundary to accommodate space for the vegetation. • In undertaking design, contractor with NEA to consult with communities in 500m of the site boundaries to get their views and input into the site layout (records of consultations are to be kept) • Designs will keep new impermeable surfaces to a minimum. • Cable trenches will be kept fully covered at all times to prevent H&S incident or small wildlife falling into them. • Design to provide spill prevention kits (sorbent pads, loose sorbent material, etc.) at storage areas and other at-risk locations within clearly labelled containers. • Locate new transformers; storage areas; and septic tanks/soak away at least 50m from waterbodies and borewells to reduce pollution risk, if closer proximity is required due to site layout further assessment to be carried out to demonstrate using a source-pathway-receptor model there will be no adverse impact on aquatic ecology or human health. • Septic tanks/soak aways will be placed away from drainage routes, waterlogged areas and shallow groundwater. • Internal access roads to be surfaced with asphalt or concrete. • Comply with Labour Accommodation Requirements appended to the IEE • For control buildings and other internal workspaces provide adequate natural and/or artificial lighting levels to meet the IFC EHS Guidelines on Occupational H&S (Table 2.3.3. Minimum Limits for Workplace Illumination Intensity) and take a life-cycle approach to detailed design, considering the use of construction materials and the energy and water efficiency of the building during operation adopting the “green building” concept e.g., using natural ventilation for reducing the need for air conditioners. Exhaust fans to be provided in kitchens and toilets. Detailed design is to include rainwater harvesting and enable NEA to readily fit solar panels on building rooftop once operational. If solar panels are included in the scope they must not contain hazardous materials e.g., cadmium, lead, or selenium. Equipment purchased for use on the project is to be accompanied by	• ADB SPS (2009) • IFC EHS General Guidelines • IFC EHS Electric Power T&D Guidelines • ILO Worker Accommodation[2] • GoN laws and regulations (Chapter 2 of IEE)	EPC Contractor Include in EPC contract cost Before design approval for further implementation during construction phase	NEA PMU / PISC

		letter from the manufacturer stating its composition and the leaching potential of any heavy metal content to determine if it is acceptable and how it is to be disposed on at end-of-life. Solar panels to have an anti-reflective coating to minimize glint and glare and maximize light absorption, racking to be anti-reflective. • Control building and other internal workspaces design will provide for sanitation and welfare facilities as per national regulations and international GIIP including indoor toilets with hand washing facilities (minimum of 1 unit to 6 males and 1 unit for 6 females shall be provided, it should not be necessary to go outside to use the toilets) connected to septic tank/soakaway and a dedicated cooking area with provision for non-wood cooking / clean eating area / rest area / segregated sleeping area for staff on-site etc. ILO worker accommodation guidelines to be followed - see annex on permanent accommodation provisions. • Dedicated shelter to be provided at the site entrance for use by security guards, shielding them from rain, wind, and extreme (hot / cold) temperatures. Separate accommodation will be provided for security guards on break. • All wastewater to be connected to existing sewerage system or septic tank with soak away so no untreated wastewater will be disposed of to surface water or ground in operation, septic tank/soakaway effluent to meet national general wastewater standards or IFC wastewater discharge limits, whatever is the most stringent. • Use of pit latrines and disposal of untreated sanitary wastewater is prohibited. • Design to ensure all lighting is of energy efficient LED type with solar powered LED lighting where practical Use of fluorescent/HPSV lamps will be avoided since they are less energy efficient/classed as hazardous waste for purposes of disposal. • Minimal outdoor lighting for H&S purposes to be installed to minimize disturbance to nocturnal wildlife. Outdoor lighting to be installed must be of low intensity with little or no blue wavelength and operated using passive infrared (PIR) technology movement sensors set at person height so as not to be kept permanently on overnight, it must be directional and shielded, so light does not fall outside substation boundaries. If lit externally buildings will be designed with non-reflective dark colored cladding materials to avoid reflecting light. • Ensure conductors and/or jumpers are fitted with “bird sensitive” design measures e.g. adequate separation between live and ground or and insultation.			

Topic	Activity / Issue	Commitment	Applicable Project Standards / Guidelines	Implementation Responsibility (Budget Source and Timing)	Monitoring Responsibility
		•	• ADB SPS (2009) • IFC EHS General Guidelines/Occupational and Community Health and Safety • GoN laws and regulations (Chapter 2 of IEE)	• EPC Contractor • Include in EPC contract cost • Before design approval	NEA / PMU PIS
	SS, DC and DRC Water supply	• Potable water will be supplied that meets national drinking water standards (full suite) as part of the design. • For on-site sources proposed undertake baseline water quality sampling per the EMoP to confirm suitability and as necessary design is to include additional water treatment, purification and storage facilities to facilitate safe drinking water supply. • Where a new drinking water supply for operation is required or additional water will be taken from an existing source the location, depth and other details of borewell to be informed by a detailed hydrogeological study also describing the availability of water taking into account climate change, mapping existing groundwater users, the current water abstraction rates and the additional volume of water required to be abstracted and the residual water balance at the end of the dry season. • Groundwater abstraction must avoid creating a water stress situation during the dry season for existing groundwater users and must ensure the baseflow of streams is not reduced. No groundwater will be used in locations without additional groundwater capacity – in other locations groundwater will only be used after it has been	• ADB SPS (2009) • IFC EHS General Guidelines GoN laws and regulations (Chapter 2 of IEE)	EPC Contractor Include in EPC contract cost Before design approval for further implementation during construction phase	NEA PMU / PISC

		confirmed through assessment that there will be no additional stress on groundwater resources as a result. • If water supply is unavailable on site, ensure regular supply of bottled water meeting drinking water standards to be secured. No groundwater will be used in locations without additional groundwater capacity – in other locations groundwater will only be used after it has been confirmed through assessment that there will be no additional stress on groundwater resources as a result.			
	SS, DC, and DRC Health and safety	• All electrical hazards will feature written and visual warning signs that meet the IEEE standards to include the ISO 7010 "Hazard Type: Electrical Symbol" warning of the risk of electrocution with an internal fence for high-risk equipment • Design to include lightening protection and earthing including earth mats in control buildings • Design of control building and other internal workspace to include emergency exits with emergency exit signage • Provide fully stocked, in-date first aid kit installed in a prominent, signed position, first aid posters and emergency contacts to also be displayed • Provide eye wash station and water supply to shower located near storage areas for fuel/oil/chemicals	ADB SPS (2009) • IFC EHS General Guidelines/Occupational and Community Health and Safety • GoN laws and regulations (Chapter 2 of IEE)	EPC Contractor Include in EPC contract cost Before design approval	NEA PMU/ PISC

	SS, DC and DRC Fire safety	• All substation buildings and other project facilities will be designed and constructed according to national fire safety standards, emergency response planning and response as well as international engineering best practice/good EHS practices • Separation walls or fire barrier walls shall be provided between the transformers and between transformer and nearby building. • Buildings including security cabin and high-risk locations outdoors to include smoke and/or heat detectors • Provide automatic fire alarm and fire suppression system in control building and at high-risk locations outdoors. • Provide sand buckets, full of sand, placed in a prominent, signed location near to fire-risk locations such as transformers and oil storage areas • Provide fire extinguishers (including for oil and electric fires) in a prominent, signed location in all buildings and security cabin and near to fire-risk locations such as transformers, DG sets, and oil storage areas with service and expiration dates clearly labelled along with posters on fire safety.	• ADB SPS (2009) • IFC EHS General Guidelines • IFC EHS Electric Power T&D Guidelines • GoN laws and regulations (Chapter 2 of IEE)	EPC Contractor Include in EPC contract cost Before design approval	NEA / PMU PISC
	SS, DC and DRC Access roads	• No new permanent access roads will be constructed. • Existing access roads to the substations, DC and DRC will be surfaced with asphalt or concrete prior to the commencement of works to minimize dust impact, the contractor will be responsible for surfacing the roads unless otherwise agreed - the road level must not be increased without adequate drainage being provided to avoid surface water entering adjacent properties where present. • Road safety signs including speed limits to be placed on the access roads. • Speed limits for traffic once turning off the highway will be capped at 20 km/hr. • National speed limits to be followed on the highways.	• ADB SPS (2009) • IFC EHS General Guidelines • GoN laws and regulations (Chapter 2 of IEE)	EPC Contractor Include in EPC contract cost Before design approval	NEA / PMU PISC
	TL, SS, DC and DRC Geohazards, slope stability and climate hazards	Identify presence of any unstable land and avoid these during the detailed design. Select an appropriate design for all civil and structural components including foundations considering climate factors, seismic and slope stability risk All buildings will be designed in accordance with national building safety codes and standards for earthquake resistance plus international good practice seismic design standards.	ADB SPS (2009) IFC EHS General Guidelines IFC EHS Electric Power T&D Guidelines GoN laws and regulations (Chapter 2 of IEE)	EPC Contractor Include in EPC contract cost Before design approval for further implementation during construction phase	NEA PMU / PISC

		• Designs to be checked for seismic safety by design team and by an independent expert, separate to design team, to confirm international good practice seismic design standards are met. • Identify any unstable land and avoid these in the layout. • If DRC sites are not on flat land conduct geotechnical/slope stability analysis with slopes to be graded with drainage installed to minimize landslide risk. • Identify presence of floodplain, drainage routes or depressions that get waterlogged in the rainy season and avoid these during detailed design. • Conduct flood and drainage risk assessment and incorporate effective drainage design (at 1 in 100 years allowing for climate change) to prevent possible flooding or waterlogging of SS equipment during the wet season. • Final surface level of towers, substation, DC and DRC will be at least 0.5 m above the existing ground level or highest flood level including an allowance for climate change based on the findings of the climate change assessment prepared for the Project (whichever is higher) • Place electrical equipment above the flood level whilst ensuring that surface runoff from the project site is no more than the greenfield runoff rate through attenuation on site (retention ponds) to avoid exacerbating flooding of the adjacent land. • All designs shall incorporate climate change adaptation measures per the climate risk assessment for the project. Construction activities must be planned not to limit the availability of or restrict access to water sources (e.g., groundwater) used by local communities			
	SS, DC and DRC Drainage	• Identify and inventory the presence of surface water including streams/ponds and groundwater sources including springs/wells/pumps within the site boundary and adjacent, confirming if any are used by the local communities for drinking water or other purposes • Natural flow of any surface water or drains must not be obstructed or if not possible diverted through a drainage system to another direction. • No surface drainage will be permitted to discharge directly to surface water bodies, detailed design to include sediment traps and oil interceptors to be fitted. • Provision of oil-water separator on all surface water drainage before discharge off-site. • Internal roads will have a camber to allow surface water to run off with side and cross drainage provided. •	• ADB SPS (2009) • IFC EHS General Guidelines • IFC EHS Electric Power T&D Guidelines • GoN laws and regulations (Chapter 2 of IEE)	EPC Contractor Include in EPC contract cost Before design approval for further implementation during construction phase	NEA PMU / PISC

Topic	Activity / Issue	Commitment	Applicable Project Standards / Guidelines	Implementation Responsibility (Budget Source and Timing)	Monitoring Responsibility
Equipment specifications and design parameters	All Components Hazardous Materials	• • No asbestos containing materials of any type will be used in the design and construction of project facilities.	• ADB SPS (2009) • GoN laws and regulations (Chapter 2 of IEE) •	EPC Contractor Include in EPC contract cost Before design approval for further implementation during construction phase	NEA PMU / PISC

Topic	Activity / Issue	Commitment	Applicable Project Standards / Guidelines	Implementation Responsibility (Budget Source and Timing)	Monitoring Responsibility
	SS, DC and DRC Diesel generators	• Only "green" DG sets are to be used with supplier certification on meeting the project noise standards and GON emission standards. • DG sets shall be installed outside in an acoustic enclosure or housed in a separate building away from other buildings. DG sets to be provided with visco damper type vibration dampening pads (suitable for the loads and vibration they are to carry) with minimum vibration transmitted to the surface the DG rests on. • Stack emissions of DG set to comply with national emission standards with the stack height designed according to both national and the IFC EHS guideline requirements.	• ADB SPS (2009) • IFC EHS General Guidelines • IFC EHS Electric Power T&D Guidelines • GoN laws and regulations (Chapter 2 of IEE)	EPC Contractor Include in EPC contract cost Before design approval for further implementation during construction phase	NEA PMU / PISC
Detailed designs	All Components		• ADB SPS (2009)		

	Community Consultations	• Contractors to undertake and document meaningful consultations with potentially affected persons and local communities within 500m of the DRC as well as other stakeholders including local authorities and public utilities during design in order that any concerns raised can be reflected in the choice of site layout and construction method.		EPC Contractor Include in EPC contract cost Before design approval for further implementation during construction phase	NEA PMU / PISC
	TL, SS, DC and DRC Review of documentation, update of the IEE	• Detailed designs will be reviewed by the contractor and NEA to confirm all measures required by the IEE/EMP have been adequately incorporated and that they reflect international engineering best practice/good EHS practice before they are approved. • Prior to NEA approval of the designs and commencement of construction, ensure that NEA have updated the IEE as required to reflect the final design, seeking ADB clearance of any updated IEE before works start by contractor.	• ADB SPS (2009)	EPC Contractor Include in EPC contract cost Before design approval for further implementation during construction phase	NEA PMU / PISC

Table 2: Pre-construction Phase EMP

Topic	Impact / Issue	Commitment	Applicable Project Standards / Best Practice	Implementation Responsibility	Monitoring Responsibility
Management Planning	All Components General, unanticipated impacts and corrective actions	• Comply with the definite version of the EMP which is the version disclosed on ADB's website. This includes any measures in an updated IEE following design or any updates in response to unanticipated impacts. • Comply with all applicable national and state environment, health, and safety (EHS) regulatory requirements in addition to the mitigation measures set out in the EMP – if there is any conflict between national requirements and measures set out in the EMP the most stringent provisions will take precedence • Comply with the EHS codes of practice (ECoP) and Labour Accommodation Requirements appended to the IEE • Comply with any corrective action plan required by NEA, contractor to cover the costs where corrective action is required due to non-compliance on behalf of the contractor, its subcontractors or third parties. • Do not engage in any activities described on the ADB Prohibited Investment Activities List in Appendix 5 of ADB's SPS (2009) • Ensure all subcontractors and third parties, irrespective of being formally or informally employed also comply with the EMP and any updates to it, as well as the CSEMP and that this responsibility is cascaded down any chain involved. • Put in place appropriate incentives and/or penalties for (non-) compliance by workers related to use of PPE, and any violations of the Contractors Code of Conduct.	ADB SPS (2009)	EPC Contractor Include in EPC contract cost Before the start of any related works including site establishment, preparation and clearance works then ongoing through project implementation	NEA PMU / PISC

	All Components CSEMP	• Preparation for NEA approval and implementation of the CSEMP and its associated management sub-plans reflecting the EMP requirements and international engineering best practice/good EHS practices-CSEMP shall include subplans as indicated in the EMP main text, such as: 1 **Construction Method Statement** Identifying all construction activities, schedule, access routes, anticipated traffic volumes, and construction methods to be used as well as temporary construction facilities needed and their location e.g., laydown areas, stores, worker rest areas, toilets/washrooms, worker overnight accommodation etc. 2 **Pollution Prevention Plan and Emergency Response Plan(s)** Covering dust and emissions to air management, noise management, the protection of water resources and environmentally sound and safe storage, use, and disposal of all fuels, chemicals and oils used on site and an emergency preparedness and response plan in the event of any leaks or spills (e.g., of oil, etc.) or an incident such as flood. Particular attention to receptors in 500m and along access roads. Include clear schedule for damping of site and access roads, description of water resources requirement, and time and activity restraints. Include pollution monitoring procedures and pre-construction data. Including emergency response plan to be prepared for construction.	• • ADB SPS (2009) General IFC EHS Power Guidelines/Electric health in T&D Guidelines • ILO Safety and H Construction	EPC Contractor Include in EPC contract cost Before the start of any works including site establishment, preparation and clearance works for NEA approval then implement throughout construction phase	NEA PMU / PISC

		3 **Occupational Health and Safety Plan including Risk Assessment and Emergency Response Plan(s)** See annex, H&S plan to include emergency preparedness and response plan including flow chart and contact details to deal with situation should any construction worker or community member be impacted. 4 **Community Health and Safety Plan including Risk Assessment and Emergency Response Plan(s)** Outlining all the relevant measures in this EMP relating to community health and safety. Community Health and Safety Plan shall include flow chart and contact details to deal with situation should any community member be impacted. 5 **Biodiversity Management: Invasive Species Control Procedures and Wildlife Encounter Protocol** Including (i) prohibitions on hunting, poaching, collection of firewood, restricted areas etc. (ii) a wildlife incident reporting procedure and emergency fauna rescue and handling procedure including contractors of forest officials, nearest veterinary etc. (iii) measures to avoid the spread of invasive species, and (iv) a chance find procedure for routine findings of small animals encountered in work areas. For works in 500m of BZ, KBA, IBA and forest land additional ecological supervision will be put in situ. 6 **Solid and Hazardous Waste Management Plan** Dealing with all solid and hazardous waste as well as wastewater generated in an environmentally sound and safe manner. Where possible it will ensure surplus materials will be reused or recycled, disposal will be the last resort. Plan shall also set out waste monitoring procedures.			

		7 Traffic Management Plan Including detailed site access route and receptors adjacent, parking areas, traffic controls e.g., speed limits, delivery timings, ensuring use of well-maintained vehicles, access road improvements, driver training and permits etc. Considering both the safety of pedestrians and vehicles and need to avoid traffic congestion; it is to be developed in consultation with relevant local authorities to ensure proper execution of traffic controls including where temporary blockage of a road or footpath is needed for installation. **8 Labor Management Plan** Addressing employment of migrant workers, sanitation and welfare, gender-based violence/sexual exploitation, abuse, and harassment prevention etc. Including details of construction camp site/overnight accommodation meeting the requirements of ILO for labor accommodation, see annex. **9 Code of Conduct** **10 Chance Find Procedure for physical cultural resources** Measures for coming across unknown archaeology during works including stop works and reporting to the Department of Archaeology. **11 Communication Plan** Outlining stakeholder consultation for the construction period. Provides a schedule for regular meetings, includes different communication methods as identified in the IEE.			

Topic	Impact / Issue	Commitment	Applicable Project Standards / Best Practice	Implementation Responsibility	Monitoring Responsibility
		12 **Training and Induction Plan** Describing the types of EHS training required during construction for staff, schedule of training to be included. • CSEMP and its associated management sub-plans will be living documents, to be updated as required and reapproved by NEA as construction proceeds, if construction methods or site conditions change, in response to an incident, near miss etc. • CSEMP will identify all temporary construction facilities needed e.g., laydown and storage areas, temporary workers facilities etc.			
Regulations, permits etc.	<u>All Components</u> Permits and Licenses	• Acquire all requisite environment, health, safety and labor permits and licenses for construction activities or construction plant as required by national laws and regulations, prior to the commencement of works and then maintain them. • If the route or site has changed since the national IEE approval was granted then it must be confirmed in writing that no further update of the national IEE is required to assess the changes. • Statutory H&S and labor requirements including permits, licenses, and insurances for all workers to be obtained and maintained. • Medical insurance will be provided for all workers with sick leave allowance of at least 12 days to ensure symptomatic workers do not attend site due to no work-no pay policies. • Insurance to include a community liability clause for payment of compensation in case of any accidents because of construction.	• ADB SPS (2009) • GoN laws and regulations (Chapter 2 of IEE)	EPC Contractor Include in EPC contract cost Before the start of any works including site establishment, preparation and clearance work then implement throughout construction phase	NEA PMU / PISC

Topic	Impact / Issue	Commitment	Applicable Project Standards / Best Practice	Implementation Responsibility	Monitoring Responsibility

Temporary facility	All Components Selection of temporary construction facilities	• Local communities within 500m to be consulted when selecting sites for temporary project facilities prior to finalization. • Provide a central covered warehouse for storage of construction materials etc. • Only volumes of material required for the day's work will be stored on-site • No borrow pits or quarries will be established and only licensed off-site materials will be used. Due diligence will be undertaken before the contractor signs any contract with an existing borrow pit or quarry for fill material etc. This includes a review of the location, licensees etc. • No concrete batching or hot mix will be established. • All temporary facilities including material and waste storage areas and offices will be sited in agreement with NEA • Contractor to seek to locate all temporary construction facilities required including laydown and storage areas within the boundaries of NEA land (substations) except for overnight accommodation that could be provided in existing properties off-site. • If other public or private land is required for temporary construction facilities noisy and dusty facilities or those that may generate sediment laden runoff or wastewater (e.g., refueling areas, maintenance yards, storage areas, temporary worker camps) must be sited 500m from residential property and other sensitive receptors (houses, schools, clinics, temples, etc.) and 100m from surface water or groundwater resource. • Laydown and storage areas that are not potential pollution sources may be located 50m distant but must not block accesses or road use. • No temporary facilities will be established in forest or other natural habitat. • No public or private land requiring clearance of vegetation or supporting forest habitat or having waterbodies is to be used. No cutting of trees or mature vegetation clearance will be allowed for temporary facilities	• ADB SPS (2009) • Project LARP • GoN laws and regulations (Chapter 2 of IEE)	EPC Contractor Include in EPC contract cost Before the start of any works including site establishment, preparation and clearance work then implement throughout construction phase	NEA PMU / PISC

		• Temporary land use to be negotiated with private landowner and compensated by the Contractor in line with the LARP entitlement matrix, submit land ownership papers and copy of agreement for temporary land use with a photographic record of preproject condition • A photographic record will be made of the preconstruction condition of land used for temporary facilities before construction to inform the reinstatement works • After completion of the construction work the temporary structures shall be completely removed and the land will be restored to its earlier condition.			

Topic	Impact / Issue	Commitment	Applicable Project Standards / Best Practice	Implementation Responsibility	Monitoring Responsibility

Staffing	All Components Inadequate staff to provide supervision and oversight	• NEA, PISC and contractor are to appoint a suitably qualified and experienced, dedicated environment, health and safety staff as per the EMP requirements • Ensure each active construction site and subcontractor has adequate health and safety supervision to ensure the H&S of all workers and local communities • Do not discriminate and proactively encourage the employment of (i) suitably skilled women, and (ii) local employment for unskilled roles whilst ensuring suitably qualified and experienced workers for skilled roles; noting that all workers must be appropriately skilled given the hazardous nature of works. • No child will be employed, and no under 18s will be engaged on construction site (hazardous work). • Provide medical/accident insurance for all workers (formal and informal) for the duration of their contracts as well as at least 12 days of sick leave for all construction workers. • National Policy of Labor Act 2074 (2017) to be abided.	ADB SPS (2009)	EPC Contractor Include in EPC contract cost with BOQ line for staff Staff in place prior to the start of construction and ongoing through project Implementation	NEA PMU / PISC
	All Components Induction and Orientation	• NEA to prepare a detailed training plan upon loan effectiveness detailed how training and awareness raising activities required by the EMP will be conducted.	ADB SPS (2009)	EPC Contractor Include in EPC contract cost	NEA PMU / PISC
		• NEA to conduct training with support of PISC. Ensure all members of contractor's safeguards team, design team, and construction management team attend NEA EMP trainings. Contractor to conduct their own trainings for their construction management and provide all workers and visitors on site, irrespective of them being formally or informally employed by the contractor, subcontractor or third party with an EHS induction before being allowed on site – induction to cover orientation on EHS requirements and roles and responsibilities in relation to EMP implementation, dos and don'ts in relation to the construction site, employer provided staff accommodation, code of		Before the start of any works including construction site establishment then on an ongoing basis	

		• conduct and interaction with local communities, IBA, forest habitat, interaction with wildlife etc. Ensure topics covered by training and induction include, but are not limited to, good housekeeping at all times; environmentally safe and sound waste management practices; hygiene and communicable disease prevention including HIV/AIDS; gender-based violence and sexual exploitation, abuse and harassment prevention; code of conduct, interaction with local communities and culturally acceptable practices; biodiversity conservation awareness; fire safety prevention; forest fire risk; • prohibition on firewood and NTFP collection by workers; prohibition on trapping, hunting, fishing, or poaching by workers; chance find procedures; H&S including use of PPE; etc. Contractors to carry out awareness raising for all construction workers about the GRM at the start of their employment on site including disseminating GRM contact details on noticeboards at construction site offices and at employer provided staff accommodation. Suggestion boxes to be provided for construction workers at construction site offices and at employer provided staff accommodation. • Prepare with guidance of health experts HIV/AIDS and communicable disease information video/brochures/leaflets for distribution to all workers during induction, covering factual health issues as well as behavior change issues around the transmission and infection of HIV/AIDS and other communicable diseases including improved • sanitation. • Prepare with guidance of labor experts a worker Code of Conduct and information video/brochure/leaflet for distribution to all workers during induction addressing culturally acceptable practices etc. Code must be informed by the CSEMP and address the following aspects: o Zero tolerance in respect of health and			

		safety ○ Requirement on always wearing PPE on site ○ Zero tolerance of bribery or corruption ○ Respect for local community and customs, avoiding community conflict situations especially for vulnerable groups ○ Zero tolerance of illegal and unacceptable activities/behavior, including but not limited to engagement in: prostitution; gender-based violence/sexual exploitation, abuse, and harassment; illegal sale or purchase of alcohol; sale, purchase, or consumption of drugs; gambling; fighting ○ Alcohol and drugs policy and testing regime ○ Role of workers in good housekeeping ○ Role of workers in maintaining good hygiene ○ Respect of wildlife and the environment ○ Description of disciplinary measures for infringement of the code of conduct and other employer rules (e.g., immediate removal from site, fine etc.)			

Communications	All Components in or adjacent to the public domain Advance Notice and Consultation on Works Schedule	• No works will start until NEA has locally disclosed the IEE and any update to it with executive summary translated into Nepali and any other relevant local languages via the NEA website, NEA offices, existing substations, and construction site offices. Brochures and posters on the main findings of the IEE and where the full version can be accessed, as well as a translation of the executive summary of the IEE, will be printed in local language and made available/displayed for public scrutiny at places easily accessible to affected persons. • Directly liaise one-on-one with receptors immediately adjacent to site boundary and access roads to specifically notify them about the commencement of work etc. • Undertake face-to-face consultations with all communities, residents, schools, clinics, temples in 500m of the site and along access roads to notify them one month prior to the commencement of works of the intended start date and schedule • Prior to the commencement of works all activities will be announced in local papers and on site and local community notice boards at least once month prior to works • Provide information to the general public about the scope and schedule of construction activities and expected disruptions and access restrictions at least 72 hours before they occur. • Local communities as well as individual property owners within 500m are to be consulted when selecting sites for temporary construction facilities outside of substations prior to finalization of their location. • Road authorities will be notified when oversize heavy loads need to be transported and they will be escorted by the police • In relation to cumulative impact contractors to liaise with other utilities regarding the timing and extent of other construction works in the project area of influence and ensure plans for construction works are coordinated so emissions/disruption/ disturbance are minimized.	• ADB SPS (2009)	EPC Contractor Include in EPC contract cost Before the start of any works including site establishment, preparation and clearance works then implement throughout construction phase	NEA PMU / PISC

	All Components GRM	• NEA with support of contractor to inform all potentially affected persons and local communities within 500m of TL, substations, DC, and DRC and directly affected with other components as well as the • GRM process and means of submitting project grievance to Inform all residents and businesses of the GRM in advance of works (at least one month). • Community awareness raising of the GRM will be undertaken verbally, through community meetings, one-on-one consultations with landowners; through the distribution of notices/pamphlets/posters; and through other media outlets. • Provide notice boards at all substations, construction site offices and active work sites including details of the GRM including the name, designation, contact numbers including phone/SMS/What's App, address of both the NEA and contractor's GRM focal persons plus the timeline and process of redressal together with a suggestion box that will be regularly checked for any grievances received.	• ADB SPS (2009) Project GRM	EPC Contractor Include in EPC contract cost Before the start of any works including site establishment, preparation and clearance works then implement throughout construction phase	NEA PMU / PISC

Topic	Impact / Issue	Commitment	Applicable Project Standards / Best Practice	Implementation Responsibility	Monitoring Responsibility

Hydrology	TL, SS, DC and DRC Water Use	• Any piling, drilling or excavation works within 50m of boreholes and wells used as a drinking water source by local communities will require pre-construction and post construction water quality monitoring against GoN drinking water standards to ensure there is no contamination of the supply. • Construction water to ideally be sourced from an existing licensed commercial supplier (preferred option especially for potable water supplies) where available or rainwater harvesting. • If using an existing surface water or an existing borewell for construction water, permissions to be obtained from authorities together with the agreement of local communities. • Prior agreement is required from local community users to use any existing surface water/borewell or local piped water either temporarily during construction or permanently for substations; in cases where use of local water source is not agreed contractor to import tanked water to the project area. • No groundwater will be used in districts without additional groundwater capacity – in other districts groundwater will not be used only after it has been confirmed through assessment there will be no additional stress on groundwater resources as a result.	• ADB SPS (2009) • GoN laws and regulations (Chapter 2 of IEE)	EPC Contractor Include in EPC contract cost Before the start of any works including site establishment, preparation and clearance work then implement throughout construction phase	NEA PMU / PISC

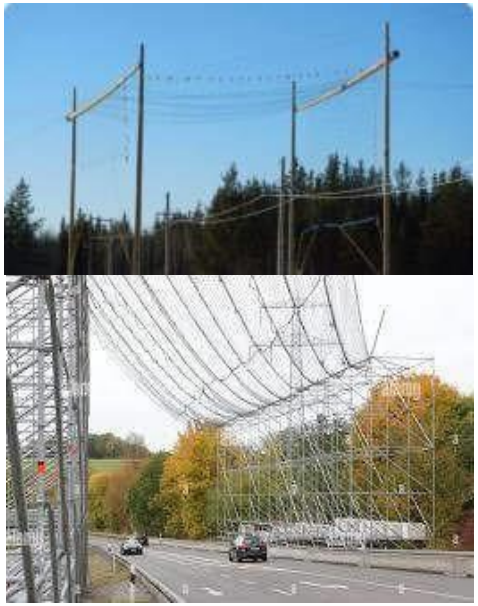
Topic	Impact / Issue	Commitment	Applicable Project Standards / Best Practice	Implementation Responsibility	Monitoring Responsibility

	TL, SS, DC and DRC Water Pollution	• If any surface waterbodies or groundwater sources are within 500m, undertake a baseline water quality sampling as per the EMoP to confirm their current water quality status at least one week prior to the commencement of any activity onsite. • Plan for designated impermeable fuel/oil/chemical hazardous materials/waste storage areas bunded to 110% capacity and located at least 50m from surface water and groundwater sources. • Storage areas should be capable of storing all the hazardous materials used and waste materials generated. • Storage areas shall be well ventilated. • Fuel and diesel storage tanks will be sited in suitably sized and constructed bunded areas that are designed to be impervious to water and fuel. The bund volume will be designed to no less than 110% of the tank volume. Loading and off-loading connections will be located over secondary containment. All health and safety provisions will be made for fire hazard etc. • Refueling procedure will be developed, which will include a restriction on refueling within 50m of any watercourse. Designated areas with impermeable surface will be assigned for refueling to minimize spillage to soil.	• ADB SPS (2009) • IFC EHS Guidelines: wastewater and ambient water quality • GoN laws and regulations (Chapter 2 of IEE)	EPC Contractor Include in EPC contract cost Before the start of any works including site establishment, preparation and clearance work then implement throughout construction phase	NEA PMU / PISC

Utilities and Infrastructure	TL, SS, DC and DRC Disruption to supply	• Check with relevant local authorities (electric, water, telecoms) whether there are known pipes, cables, or other utility lines and carry out a scan using cable avoidance tool to identify any unknown underground utilities prior to excavation. • Contractors to identify in consultation with service providers appropriate measures to minimize period of disruption to utilities and reduce health and safety risks during installation. If services must be disrupted contractors (via service providers if appropriate) to notify affected communities well in advance of any power outage etc. Should utilities need relocating or required to be removed consult with the relevant utilities and local community to ensure that there is no change in supply because of these changes. • Obtain necessary clearances consistent with the regulatory requirements from other utilities that could be affected by the Project (municipality for street furniture, electric, water, sewerage, Telecommunications, road, rail etc.) • All electricity and gas supply networks in the Project area will be kept operational, particularly during the winter months. Liaise with the relevant utilities operators to ensure they remain operational. • In relation to cumulative impact liaise with other utilities regarding the timing and extent of other construction works in the same location and ensure plans for construction works are coordinated so emissions/disruption/ disturbance are minimized. • For private property or public utilities/street furniture that may be damaged during construction, including from potential breaking/drilling vibration damage (buildings, roads, drains etc.) photographic and/or structural pre-condition surveys are to be completed and agreed with NEA prior to any works, including site establishment. To be documented in a pre-project condition report, which will serve as baseline in case any inadvertent damage or vibration impact to	• ADB SPS (2009) GoN • laws and regulations (Chapter 2 of IEE)	EPC Contractor Include in EPC contract cost Before the start of any works including site establishment, preparation and clearance work then implement throughout construction phase	NEA PMU / PISC

		property occurs. If risk of structural damage to adjacent properties from vibration identified due to current condition, consider alternative construction methods or temporary relocation of occupants during works if at risk.			
Occupational Health and Safety	All Components General	• Strictly implement all the OHS measures outlined in the annex and all the measures outlined below. • Informed by risk assessment prepare H&S plan for approval by NEA in accordance with the IFC EHS General Guidelines on OHS, considering occupational and community H&S and including adherence to electrical safety standards and emergency preparedness and response plan with communication systems and protocols to report an emergency. For • all pre-construction and construction works comply with GoN rules and regulations for the protection of workers. • During construction works, ensure qualified first aider and trained fire marshal is always available on-site with an appropriately equipped first aid kit and appropriate fire extinguisher and other firefighting equipment immediately available for use. • Contractors will set up an accident reporting system for any health and safety incidents (near miss, minor, lost time, fatal) involving workers or community to be reported to NEA within 24 hours of occurrence with a response plan detailing the incident and how its reoccurrence will be avoided within 48 hours. Record of all incidents and response taken should include date, time, details of incident, treatment given and outcome, and lessons learnt for the future.	• ADB SPS (2009) • Project GRM • IFC EHS Guidelines: Electrical Power and Distribution (2007) • IFC General EHS Guidelines: Occupational Health and Safety • IFC General EHS Guidelines: Community Health and Safety • ILO safety and health in construction • GoN laws and regulations (Chapter 2 of IEE)	EPC Contractor Include in EPC contract cost Before the start of any works including site establishment, preparation and clearance work then implement throughout construction phase	NEA PMU / PISC

		Contractors will ensure all workers are covered by insurance to pay out in the event of a disability or fatality.			

		• Emergency contact number and details for medical, fire, etc. are to be displayed in all construction sites. Plan to include emergency drills to be held to ensure prompt response to medical incident or natural hazard that did occur. If working under live lines (HV or LV) then a safety scaffold will be installed so that the workers cannot come in contact with the OHL, with warning signs provided – all works under HV and LV lines must have an activity specific risk assessment and management plan give the high risk of an incident. 			

Topic	Impact / Issue	Commitment		Applicable Project Standards / Best Practice	Implementation Responsibility	Monitoring Responsibility

	All Components Labor and accommodation	• Design of temporary worker camps/overnight accommodation to conform to national requirements and international good practice per the annex. • Contractors to provide all basic requirements (beds and beddings, mosquito nets, artificial lights, natural light, windows and ventilation, fans, emergency exits, firefighting equipment, kitchen and dining halls, mobile charging points, toilets and washing facilities, potable drinking water, recreational space etc. The contractor shall ensure the camps established for providing accommodation to laborers engaged in construction activities meet the requirements which are set out in the annex. • No temporary worker camps/overnight accommodation will be established in forest or other natural habitat. • Shaded rest area that is accessible and can accommodate the number of workers at the active works site • Tents may be used for day rest areas but all overnight accommodation for workers must be provided in a structurally sound built structure providing adequate shelter from rain, wind etc. • Source water from an existing licensed commercial supplier (preferred option) where available			EPC Contractor Include in EPC contract cost Before the start of any works including site establishment, preparation and clearance work then implement throughout construction phase	NEA PMU / PISC

Topic	Impact / Issue	Commitment	Applicable Project Standards / Best Practice	Implementation Responsibility	Monitoring Responsibility

	All Components Sub-contractors	• All subcontractors and third parties irrespective of being formally or informally employed will comply with the EMP and updates to it, as well as this CSEMP, and this responsibility must be cascaded down any chain involved through their subcontract • All sub-contractors will be supplied with copies of the EMP and CSEMP. • Provisions will be incorporated into all works subcontracts to ensure compliance with the CSEMP at all tiers of the sub-contracting. • All works subcontractors in the chain will be required to appoint an EHS representative who will be available on each work site at all times when their workers or their subcontractors are working during construction to support the main contractor in providing oversight of the subcontracted activities. • Use of work gangs and daily labor is highly discouraged due to less control over health and safety -- if used by any subcontractor in the chain the contractor will be required to provide additional environment, health and safety supervision.		EPC Contractor Include in EPC contract cost Before the start of any works including site establishment, preparation and clearance work then implement throughout construction phase	NEA PMU / PISC
	All Components Grievance	• Establish a formal Grievance Mechanism for workers. • Carry out awareness raising amongst formally and informally employed workers including those of subcontractors about the GRM at the start of their employment, including details of how to submit a grievance to the PMU/PISC and/or to the Contractor.		EPC Contractor Include in EPC contract cost Before the start of any works including site establishment, preparation and clearance works for NEA approval then implement throughout construction phase	NEA PMU / PISC

Topic	Impact / Issue	Commitment	Applicable Project Standards / Best Practice	Implementation Responsibility	Monitoring Responsibility

Community Health and Safety	TL, SS, DC and DRC Dust, noise and vibration	• Contractor to undertake baseline noise and air quality monitoring per the EMoP to confirm current background levels in the project area at least one week prior to the commencement of any actively on-site. • Contractor will be required to measure and confirm the distance from their construction works to sensitive receptors to confirm if the noise standards can be met based on their construction methods or if temporary acoustic barriers are required. • Contractor to avoid soil compaction, piling, blasting and other vibration inducing activities as much as possible • If piling, blasting or other vibration inducing activities are to be undertaken for construction a detailed construction noise/vibration assessment is to be undertaken by the contractor to demonstrate how construction noise and vibration levels/guidelines can be achieved at the site boundary and nearest receptors and a piling/blasting management plan is to be prepared for approval. • In locations where this is unavoidable Contractor to identify properties within the zone of influence and undertake pre-construction structural surveys to identify level of risk. If risk of structural damage to properties identified due to current condition, consider alternative construction method or temporary relocation of occupants during works if at risk. Consider need to install monitors during construction to monitor structural movement. Structural or cosmetic damage to be repaired by Contractor to at least pre-project condition at their own cost.	• ADB SPS (2009) • IFC EHS General Guidelines/Electric Power T&D Guidelines • GoN laws and regulations (Chapter 2 of IEE)	EPC Contractor Include in EPC contract cost Before the start of any works including site establishment, preparation and clearance work for NEA approval then implement throughout construction phase	NEA PMU / PISC
	TL, SS, DC, DRC	• In conjunction with the local municipality or village head in rural areas plus the media organize health and safety campaigns including the distribution of posters,	• ADB SPS (2009)	EPC Contractor	NEA PMU / PISC

Topic	Impact / Issue	Commitment	Applicable Project Standards / Best Practice	Implementation Responsibility	Monitoring Responsibility

	Community Safety Awareness	leaflets, and safety booklets to all households in Nepali or local language with strong use of graphics for construction and electrical safety community awareness raising activities in local communities and schools within 500 m of the TL and substations prior to construction and then again prior to commissioning of substations about how to avoid electrical incidents having greater emphasis on operational hazard and risks, etc. Materials will be written in non-technical language and will provide illustrations where practical. • Deliver face-to-face electrical safety awareness training to local children including their parents and/or their teachers at all educational facilities within at least 500m. • Provide construction work site safety awareness sessions at all educational facilities within 500m of any work zone and along access roads used by construction traffic. • Provide EMF awareness sessions at villages within 500m of TL and substations. The awareness sessions should provide information regarding the findings of the IEE on EMF and specifically discuss best practice reference limits for EMF and how they have been applied to the Project. • Develop and distribute leaflets/pamphlets/posters to the local community especially those living close to construction camps covering (i) health awareness including HIV/AIDS/STDs and other communicable diseases, and (ii) the conduct of construction workers that can be expected. Materials will be written in nontechnical language and will provide illustrations where practical. • Keep a record of the number of leaflets distributed and their locations.	• IFC EHS General Guidelines/Electric Power T&D Guidelines • GoN laws and regulations (Chapter 2 of IEE)	Include in EPC contract cost Before the start of any works including site establishment, preparation and clearance work for NEA approval then implement throughout construction phase	

Physical Cultural Resources	TL, SS, DC and DRC Chance Finds	• In consultation with the local community contractor will maintain an inventory of above ground physical cultural resources adjacent to the site and along the access roads checking against the findings of the IEE, including any trees where prayers/rituals are performed, and take measures to protect them during construction. • For physical cultural resources that shall be impacted receptor-specific management plan will be developed in consultation with the local community to ensure significant adverse impacts can be avoided. • Demarcation of the working area by the contractor and avoidance of encroachment outside the agreed corridor of impact. Also, demarcation of physical cultural resources (such as shrines, trees) to be avoided and retained. Ensure workers do not loiter • outside of temples etc. • A chance find procedure will be developed for implementation in the event physical cultural resources are found, to include the following procedures: o If suspected physical cultural resources are encountered, all works at the find site should be immediately halted; o The find should be assessed by a competent local official managing cultural issues, and procedures to avoid, minimize or mitigate impacts to such physical cultural objects should be agreed in writing with them. o Work should not begin until the procedures to avoid, minimize or mitigate impacts to the physical cultural resources have been agreed and implemented in full. o If avoidance is not feasible, and no alternatives to removal exist, and the project benefits outweigh the anticipated cultural heritage loss from removal which is unlikely unless in case of resource of local value, following clearance of Department of Archaeology and ADB the physical cultural resources should be removed and preserved	• ADB SPS (2009) GoN laws • and regulations (Chapter 2 of IEE)	EPC Contractor Include in EPC contract cost Before the start of any works including site establishment, preparation and clearance work for NEA approval then implement throughout construction phase	NEA PMU / PISC

		using the best available technique in accordance with relevant provisions of national heritage protection laws and decrees. o Records should be maintained of all finds, including chain of custody instructions for movable finds. All construction workers to be made aware of the chance find procedure and types of finds to be reported.			

Topic	Impact / Issue	Commitment	Applicable Project Standards / Best Practice	Implementation Responsibility	Monitoring Responsibility
Biodiversity	TL, SS, DC and DRC Project Footprint	• Follow design drawings and implement careful construction practices to avoid damage to trees and vegetation.	• ADB SPS (2009) • GoN laws and regulations (Chapter 2 of IEE)	EPC Contractor Include in EPC contract cost Before the start of any works including site establishment, preparation and clearance work then implement throughout construction phase	NEA PMU / PISC

Topic	Impact / Issue	Commitment	Applicable Project Standards / Best Practice	Implementation Responsibility	Monitoring Responsibility

Waste Management	SS Old Equipment	• Disposal of old transformers and other hazardous wastes shall be per national regulations. Other wastes will be recycled using authorized vendors or suitably engineered and licensed waste management facilities for inert or solid waste. • If any PCB contaminated transformers are to be disposed of the use of facilities capable of safely transporting (closed trucks) and disposing of hazardous waste containing PCBs will be a requirement. • Any areas of oil leaks beneath existing equipment to be removed will be excavated, stored in labelled metal drums and returned to the Contractors facilities for storage according to method statements. The labelled containers will include a reference number which correlates with the removed transformer which will be tested for PCBs using rapid test kits. • If the PCB tests indicate that the transformer oil is contaminated, the container containing the soils will be labelled as PCB waste. PCB waste shall be stored, handled and disposed of in line with national regulations.	• ADB SPS (2009) • GoN laws and regulations (Chapter 2 of IEE)	EPC Contractor Include in EPC contract cost Before the start of any works including site establishment, preparation and clearance work then implement throughout construction phase	NEA PMU / PISC

Procurement	<u>All Components</u> Material Sourcing	• Considering relevant technical and commercial considerations, the Project will seek to purchase goods and services from within Nepal. • Environmental considerations will be included in the procurement process. • Contractors will use locally sourced materials as far as practical to reduce transportation, but all raw materials will be sourced only from existing licensed sources. • Only already existing state licensed borrow pits for land raising will be allowed for use. Provide copies of the borrow pit operator's license and permit before any materials from the borrow pit are delivered to site. • Materials will not be sourced from quarries in the beds or rivers or other permanent watercourses even if they are licensed. • Construction water to be sourced from an existing licensed commercial supplier (preferred option especially for potable water supplies), where available, or rainwater harvesting. If using an existing surface water or an existing borewell for construction water, permissions to be obtained from the relevant authorities together with the agreement of local communities. • Prior agreement is required from local community users to use any existing surface water/borewell or local piped water temporarily during construction; in cases where use of local water source is not agreed, contractor to import tanked water to the project area. • No groundwater will be used in locations without additional groundwater capacity – in other locations groundwater will only be used after it has been confirmed through assessment that there will be no additional stress on groundwater resources as a result. • Construction water to be sourced from an existing licensed commercial supplier (preferred option especially for potable water supplies), where available, or rainwater harvesting. If using an existing surface water or an existing borewell for construction water, permissions to be obtained from the relevant authorities together with the agreement of local communities.	• ADB SPS (2009) GoN • laws and regulations (Chapter 2 of IEE)	EPC Contractor Include in EPC contract cost Before the start of any works including site establishment, preparation and clearance work then implement throughout construction phase	NEA PMU / PISC

		• Prior agreement is required from local community users to use any existing surface water/borewell or local piped water temporarily during construction; in cases where use of local water source is not agreed, contractor to import tanked water to the project area. • Records to be kept of all the materials used and source with copies of licenses etc • Procedures will be established to determine the acceptability of material storage conditions and to promote the minimization of storage volumes on-site			

Topic	Impact / Issue	Commitment	Applicable Project Standards / Best Practice	Implementation Responsibility	Monitoring Responsibility
Economy and Employment Livelihoods	All Components Employment	• Targets for local recruitment from the local communities will be agreed with NEA based on initial assessment of the labor market for unskilled and semiskilled work force. • Seek to manage employment expectations by explaining the number and type of opportunities in advance to local communities. • Applications for employment will only be considered if submitted via the official application procedure. • Recruitment procedures will be transparent, public, and non-discriminatory and open with respect to ethnicity, religion, sexuality, disability or gender. • Clear job descriptions will be provided in advance of recruitment and will explain the skills required for each post. • Job vacancies will be advertised in the local communities through appropriate and accessible media. • For unskilled use a 'ballot' system to ensure that employment is fair and not weighted to connected people for unskilled roles.	• ADB SPS (2009) • GoN laws and regulations (Chapter 2 of IEE)	EPC Contractor Include in EPC contract cost Before the start of any works including site establishment, preparation and clearance work then implement throughout construction phase	NEA PMU / PISC
	All Components Workers' Rights	• Contractor to allow collective bargaining and ensure that ILO core labor standards to which Nepal is a signatory are upheld. • All employees will receive at least the minimum wage as defined by national legislation. • All workers will have contracts describing their job description and conditions of work and will have the contents explained to them.			
		• Employee Code of Conduct will prohibit the workforce from participating in illegal activities, including use of illegal drugs, bribery and corruption or requesting or receiving gifts from communities.			
		• Policy limiting alcohol consumption in construction camps will be applied			

		• Workforce training will include a briefing on camp rules and awareness of local social issues and sensitivities. • No unauthorized access to, or use of, any camp facilities will be allowed. • Review measures to mitigate community health and safety impacts regularly, and consult community leaders every six months, informing them on the status of implementation and results, and discussing any changes needed to the Pollution Prevention Plan or the Community Health and Safety Plan in advance of proposed changes.			

Table 1: Construction Phase EMP

Topic	Impact / Issue	Commitment	Applicable Project Standards / Best Practice	Implementation Responsibility	Monitoring Responsibility

Training	TL, SS, DC and DRC Pollution Prevention	• Conduct bi-monthly training of workers on pollution prevention control including good housekeeping and how to clean up oil/fuel spills and dispose of contaminated sorbent material which would be treated as a hazardous waste. Include emergency preparedness and response procedures (drills) in case of spill. To include training for subcontractors before commencement of works. • Information will also be incorporated into the site induction process and will outline the role of personnel in the management of waste and emissions from site and spill response procedures. • Site induction training will be supplemented by regular toolbox talks with relevant personnel if inspections or audits highlight failings in waste management.	• ADB SPS (2009) • IFC EHS General Guidelines/Electric Power T&D Guidelines • GoN laws and regulations (Chapter 2 of IEE)	EPC Contractor Include in EPC contract cost Throughout construction	NEA PMU / PISC
	All Components OHS	• Conduct daily toolbox talks on pertinent topics related to the day's work and weekly training on occupational health and safety for all construction workers including refreshers. To include training for subcontractors before commencement of works. • Ensure workers with a specific role have attended specialized health and safety trainings related that role e.g., health and safety stewards, first aiders, fire safety officers, as well as ensuring workers have received task-specific trainings for working at height, demolition, working with electricity, etc. • Only allow suitably trained and qualified workers to work on electrical equipment and at height, these workers must have training record of attending suitable training course on electrical safety and working at height and be provided with and wear the appropriate PPE for their role. • No workers shall be allowed to work at height unless they have passed a vertigo test • Untrained workers must not be permitted to work with live electricity or to work at height.	• ADB SPS (2009) • IFC EHS General Guidelines/Electric Power T&D Guidelines • ILO safety and health in construction • GoN laws and regulations (Chapter 2 of IEE)	EPC Contractor Include in EPC contract cost Throughout construction	NEA PMU / PISC

	All Components Emergency Response	• Conduct monthly training involving all workers on emergency preparedness and response procedures (drills) in case of an occupational or community health and safety incident during construction works including fire, natural disaster, disease outbreak etc. To include training for subcontractors before commencement of works. • Emergency preparedness and response training for construction management will include modules on first aid and fire safety including include training on how to use first aid and firefighting equipment provided on-site, and scenario of potential or confirmed infection.	• ADB SPS (2009) • IFC EHS General Guidelines/Electric Power T&D Guidelines • ILO safety and health in construction GoN laws and regulations (Chapter 2 of IEE)	EPC Contractor Include in EPC contract cost Throughout construction	NEA PMU / PISC

Topic	Impact / Issue	Commitment	Applicable Project Standards / Best Practice	Implementation Responsibility	Monitoring Responsibility
	TL, SS, DC and DRC Driver Training	• Driver training, monthly, to include advice on behaviours to reduce the potential for disturbance, including use of horn, loud radios with windows open, switching engines off when not in use, strictly observing speed limits and not accelerating or braking aggressively.	• ADB SPS (2009) • IFC EHS General Guidelines/Electric Power T&D Guidelines • ILO safety and health in construction • GoN laws and regulations (Chapter 2 of IEE)	EPC Contractor Include in EPC contract cost Throughout construction	NEA PMU / PISC
Communications	All Components GRM	Contractor's safeguards team will act as site GRM Focal and keep affected persons and local communities informed of the status of work and be readily available onsite to receive, document and deal with grievances at site level. Encourage use of the GRM and clarify that this does not prevent affected persons from pursuing any legal action, if they feel it is needed, and inform communities about the ADB Accountability Mechanism and their possibility to resort to it if any grievance is not resolved by the project level GRM.	• ADB SPS (2009) • Project GRM • GoN laws and regulations (Chapter 2 of IEE)	EPC Contractor Include in EPC contract cost Throughout construction	NEA PMU / PISC
	All Components Worker GRM	• GRM will be available to all workers for receiving and handling complaints about unfair treatment or unsafe living or working conditions, ensuring no coercion nor reprisal. • Construction workers will be given access to register any grievances with the contractors or direct access to the NEA GRM Focal			

Air Quality	TL, SS, DC and DRC Release of Exhaust Gases and Fugitive Emissions	• Emission sources (vehicles such as excavators) shall be positioned as far as is practical from sensitive receptors. • Equipment and vehicles will be regularly maintained in accordance with the manufacturer's recommendations to maximize fuel efficiency and help minimize emissions; keep log of maintenance records. • Use diesel fuel that has a low sulfur content, less than 0.1% • Construction equipment and vehicles will meet national emissions standards. • Hold valid emission certificates of all construction vehicles • Belching of black smoke is prohibited. • Limit engine idling to maximum 5 minutes. • The open burning of wastes generated by project-related activities is strictly prohibited. • Avoid the use of diesel- or petrol-powered generators and use mains electricity or battery-powered equipment where practicable. • Stack emissions of temporary diesel generator set or hot mix to comply with national emission standards with the stack height designed according to both national requirements and IFC EHS General Guidelines.	ADB SPS (2009) • IFC EHS Guidelines: Air Emissions and Ambient Air Quality (2007) GoN laws and regulations (Chapter 2 of IEE)	EPC Contractor Include in EPC contract cost Throughout construction	NEA PMU / PISC

Topic	Impact / Issue	Commitment	Applicable Project Standards / Best Practice	Implementation Responsibility	Monitoring Responsibility

	TL, SS, DC and DRC Siting of Equipment	• Stationary emission sources (e.g., portable diesel generators, compressors, etc.) shall be positioned as far as is practical from sensitive receptors.			
	TL, SS, DC and DRC Dust	• Construction entrance/exit wash bays shall be provided to control sediment, dust, invasive species spread and avoid scattering of mud on the access roads • Ensure an adequate supply of bowsers and carry out watering for dust control at least twice a day on the work site, more if needed, and within 500m of work sites in dry weather with temperatures of over 25°C, or in windy weather. Dust control measures will also be implemented on all access roads within 50m of receptors. Avoid overwatering as this may make the surrounding area muddy. • Vehicle movements will be restricted to defined access routes and demarcated working areas (unless in the event of an emergency). All internal roads and access roads to substations off the highway will be asphalt or concrete surfaced. • A strict speed limit of at most 20 km/hr will be enforced for construction vehicles. • A solid temporary fencing shall be installed around the boundary/works area to minimize the dispersion of dust, it will also function as a temporary acoustic noise fence to minimize the noise and visual impact. Keep stockpiles of soil, aggregate and waste materials covered with canvas or tarpaulin when spoil heaps are not active to avoid suspension or dispersal of fine soil particles during windy days and to prevent disturbance by stray animals. • Earthwork operation will be suspended when the wind speed exceeds 20 km/h in areas within 500 m of any community. • Vehicles carrying fine aggregate materials will be sheeted with canvas or tarpaulin to help prevent dust blow and spillages. • Only use cutting, grinding, or sawing equipment fitted or in conjunction with suitable dust suppression techniques such as water sprays or local extraction, e.g., suitable local exhaust ventilation systems.			
		• Undertake sequenced construction method and revegetate areas immediately construction activities are completed in one area rather than undertaking earthworks on all parts of the site to minimize the area of bare ground exposed at any one time.			

		• Undertake weekly dust soiling checks of surfaces of adjacent properties during earthworks and help with cleaning of external surfaces of property if dust is evident. • If there is an increase in existing background air pollution or complaints are received contractor will be required to implement additional dust or noise mitigation e.g., barricading/isolating sources of dust, use of wheel wash etc. • Provide workers with N95 dust masks to be worn when ambient conditions are dusty or when dust generating activities take place.			
Hydrology	TL, SS, DC and DRC Water resources	• Construction activities must not limit the availability of or restrict access to water sources (e.g., wells) used by local communities. • Natural flow of waterbodies must not be obstructed or diverted to another direction. • No works to be undertaken within 20m of the banks of waterbodies to avoid bank slippage and loss of soil that would increase the turbidity of water. • Ensure that no construction materials or construction waste block existing drainage channels. Channels shall be kept open at all times to avoid disruption.	• ADB SPS (2009) • GoN laws and regulations (Chapter 2 of IEE)	EPC Contractor Include in EPC contract cost Throughout construction	NEA PMU / PISC
	TL, SS, DC and DRC Water pollution	• Follow liquid management and storage requirements listed below under 'soils' • No untreated wastewater will be discharged direct to surface waterbodies or groundwater. • All wastewater to be connected to existing sewerage system or septic tank with soak away, septic tank/soakaway effluent to meet	• ADB SPS (2009) • IFC EHS Guidelines: Hazardous Materials Management (2007) • IFC EHS Guidelines: Wastewater and	EPC Contractor Include in EPC contract cost	NEA PMU / PISC

Topic	Impact / Issue	Commitment	Applicable Project Standards / Best Practice	Implementation Responsibility	Monitoring Responsibility

		national general wastewater standards or IFC wastewater discharge limits, whatever is the most stringent given the receiving source. • Self-enclosed portable toilets may be used where the wastewater generated is enclosed in a container and will later be taken offsite to a municipal sewage treatment plant for wastewater treatment and disposal. • Use of pit latrines is prohibited as is open defecation and urination and uncivil use of roads or private premises by construction workers. • Treated wastewater will be used for damping down earthworks and road surfaces to mitigate dust generation. • Construction site camps will be located at least 50m from water courses. • Ensure no hazardous materials are placed where there could be spill or leak into surface water. • Locate mobile generators and site construction equipment at least 50m from groundwater resources and surface waters. • Discharge of sediment laden surface water runoff directly into surface water forbidden. Construction of sedimentation ponds is required to allow sediment to settle out of surface water runoff before release of water into the downstream environment. Sedimentation ponds for treating surface water runoff to be adequately sized for the volume of runoff, contractor to provide design calculations for approval. • Dumping of construction waste including excess spoil and concrete sludge into streams and drains will be prohibited to minimize siltation. • Provide spill prevent kits (sorbent pads, loose sorbent material etc.) at storage areas and other at-risk locations within clearly labelled containers.	ambient water quality • GoN laws and regulations (Chapter 2 of IEE)	Throughout construction	

Soils	TL, SS, DC and DRC Soil compaction, topsoil and excavated materials	• Avoid compaction impacts outside the cleared areas i.e., vehicle movements will be restricted to working areas. In wet conditions minimize use of heavy machinery and consider temporary installation of removable steel plates to protect soil and vegetation. • Minimize removal of existing vegetation and topsoil. Topsoil disturbed will be separately stored and used to restore the surface of the excavated area. • On completion of works, stockpiled topsoil will be spread over the surface of disturbed areas (if not under hard surfaces) and used in the restoration of temporary construction facilities. Once the topsoil has been replaced it will be stone picked to remove any large stones which are not in keeping with the surrounding soil texture. • Revegetation of the soils will follow using native seed mixes to Nepal and the project area. • Records of excavated soil, generated waste, and transfer records will be kept. • If topsoil is stored for more than six months, the stacks will be monitored for anaerobic conditions and manual aeration will be undertaken if they develop. • Stored subsoil and topsoil will be segregated in a manner that avoids mixing. • Topsoil stacks will be free draining. Topsoil will be stored outside the running track used by construction plant, equipment and vehicles. • Soil storage areas will be protected from vehicle movements to avoid soil compaction. • Excavation will be limited to within the agreed corridor of impact. • Infertile and rocky material will where possible be reused as fill material around foundations. If it needs to be taken off site, it will be disposed of by licensed waste management operator at designated disposal area suitable for accepting inert wastes. No spoil shall be removed from site until the disposal locations have been approved by NEA. • Under no circumstances will excess materials be dumped on private lands, dumped or pushed into any river, stream or drain at any location.	• ADB SPS (2009) • IFC EHS General Guidelines • GoN laws and regulations (Chapter 2 of IEE)	EPC Contractor Include in EPC contract cost Throughout construction	NEA PMU / PISC

		• Upon completion of subsoil and topsoil reinstatement, disturbed areas will be inspected jointly for signs of erosion, slope instability, topographic diversity, surface water drainage capacity and function, and compaction with the contractor implementing remedial measures where required.			

	TL, SS, DC and DRC Soil Pollution	• Fuel, oil, and chemicals used to be kept under lock and key and stored in labelled, sealed containers on drip trays to provide secondary containment. They will be located on an impermeable surface and be under cover. This will be located at least 50m from any surface water course or seasonal water channel. • Mount plant containing oil and diesel on drip trays to catch leaks. • Refueling operations, equipment servicing and washdown to take place on an impermeable surface at least 50m from watercourses, springs and wells, with drainage directed through oil and grease interceptors before being discharged into a settling pond prior to discharge offsite. • Regular inspections and maintenance will be carried out of secondary containment areas to confirm that they are functioning effectively. • Provide sufficient absorbent materials (e.g., sorbents, dry sand, sandbags) on-site for soaking up fuel, oil or chemical leaks/spills. • Spill response equipment (absorbents etc.) will be available in hazardous materials storage areas. • All material safety data sheets (MSDS) are kept on site with the relevant materials. • Materials that can potentially react with each other will be segregated during storage. • Hazardous chemicals will be securely stored on site in a designated storage area. • Relevant personnel will be trained in safe use and handling of hazardous materials. • Relevant construction personnel will be trained in use of spill kits and disposal practices. • Vehicles delivering fuel or hazardous liquids will carry appropriate spill kits to allow an initial response to any spill to be deployed. • All mobile plant (excluding vehicles) will be integrally bunded or will be equipped with a bund or drip tray which will be regularly inspected and emptied to prevent rainwater accumulating.		EPC Contractor Include in EPC contract cost Throughout construction	NEA PMU / PISC

Topic	Impact / Issue	Commitment	Applicable Project Standards / Best Practice	Implementation Responsibility	Monitoring Responsibility

Biodiversity	TL, SS, DC and DRC Project footprint	• Temporarily disturbed areas will be revegetated on completion of construction and the entire site will be maintained free of invasive species. • Ground cover vegetation and trees to be retained where it is not needed to facilitate construction. • Demarcation of the working areas and avoid encroachment outside these areas. • Promptly revegetate disturbed areas on completion of works with plant species native to district. • All unanticipated damage to vegetation will be restored to preproject condition and/or compensated at the cost of the contractor in line with the entitlement matrix.	• ADB SPS (2009) • IFC EHS General Guidelines • GoN laws and regulations (Chapter 2 of IEE)	EPC Contractor Include in EPC contract cost Throughout construction	NEA PMU / PISC
	TL, SS, DC and DRC Fauna	• Trees and vegetation to be cleared outside the breeding bird season, unless access to the substation site is limited due to seasonal weather conditions • Before cutting or trimming trees ecologist to check for presence of nesting birds or roosting bats. • On-site check for ground nesting birds by experienced ecologist prior to vegetation clearance if conducted during the bird breeding season. • If nesting birds are found present, work will not take place until the adult birds and young have left the nest. Meanwhile a suitably sized protection zone will be clearly marked around the nest site by the ecologist to prevent any accidental disturbance or damage. • Prior to earthworks, area will be checked by an ecologist for any signs of burrows etc. If occupied work will not take place in that area during the breeding season. Meanwhile a suitably sized protection zone will be clearly marked around the nest site by the ecologist to prevent any accidental disturbance or damage. Outside the breeding season only manual digging under close supervision of the ecologist permitted. • No works from 1 hour before sunset to 1 hour after sunrise to avoid disturbance to fauna.			
		• No fauna to be injured by work, conduct walkover at start of each day to give fauna the chance to move on. Direct intervention by ecologist if need to relocate fauna outside the works area before start of work.			

		• Excavated pits will be robustly fenced or covered to prevent fauna accidentally falling in, further an escape ramp will be provided to allow their escape. • Keep written record, supported by photographs of any animal relocations or casualties, including a cause of death if known. • Follow the wildlife identification and rescue protocol.			
	TL, SS, DC and DRC Disturbance	• Works at all sites within 500m of areas of high biodiversity value (BZ/KBA/IBA) and in or within 500m of areas supporting community forest or natural habitat will only be carried out under ecological supervision to minimize disturbance. • Use existing access roads to access work sites, in areas where access is restricted use manual labor to transport, install and string the TL to minimize the need to construct new access tracks • Demarcate the working area and avoid encroachment outside the working area. • Contractor to provide firefighting equipment at work site with compulsory basic fire training for all workers and training drills undertaken in case of forest fire; in case of incident act swiftly to avoid fire spread. • Strict prohibition on workers to enter forest or natural habitat outside the working area, and on the purchase, sale and use of firewood, timber, NTFPs, hunting and poaching of fauna by workers. • Contractor to undertake regular, compulsory awareness raising activities for all workers related to prohibitions including toolbox talks and posting information and warning signs at site officers, accommodation, patrols by security guards employed by the contractor, regular inspections of accommodation, and disciplinary procedures for any contravention by workers etc.			
		• Provide a good standard of worker accommodation with heating and meals to help discourage breaches of prohibition by workers. • Contractor to provide alternative fuel source (LPG) which will be stored in safe conditions in communal kitchen and for heating of accommodation.			

	TL, SS, DC and DRC Invasive species	• Removal and disposal of identified plant species in an ecologically sound manner. • Use wash stations at site entrance to pressure wash vehicles, plant and equipment before import to site and as needed on leaving site to minimize accidental spread • Imported materials must be free of invasive plant species			
	TL, SS, DC and DRC Pesticides	• Use of herbicides or burning to clear vegetation is strictly prohibited.			

Land Use	TL, SS, DC and DRC Damage to Property or cause detriment or inconvenience	• Condition surveys of access roads and adjacent properties to be completed before project commences. • Construction work will make effort to cause as little damage to property or cause detriment and inconvenience. If caused, NEA shall make full compensation. • All unanticipated damage to existing public and private property outside the site boundary shall be restored to pre-project condition and/or compensated at the cost of the contractor in line with the LARP entitlement matrix.	• ADB SPS (2009) • Project LARP	EPC Contractor Include in EPC contract cost Throughout construction	NEA PMU / PISC

Waste Management	<u>All Components</u> General impacts	• Excess fill from excavation works across the site to be balanced with fill. • Provide adequate facilities for handling and storage of construction materials to reduce the amount of waste that is caused by damage or exposure to the elements and a system for the collection/storage of wastes generated. • Any plant or equipment that is rejected during the installation and commissioning due to damage or failure to immediately be removed from the site and returned to the supplier. • Ensure that the waste hierarchy is followed including prevention, minimization, reuse and recycling -- maximum reuse and recycling of waste and timely removal of unusable waste according to national waste management regulations. • Restrict use of plastics and polyethene and use recyclable/biodegradable materials during construction to the extent possible. • In locations where waste is dumped (existing site conditions) the contractor will clean the site and collect the waste for onward disposal before they commence their works. Ensure sufficiently sized facilities are provided for the environmentally safe and sound collection, segregation and storage of waste (including from overnight accommodation)	• ADB SPS (2009) • IFC EHS Guidelines: Waste Management (2007) • IFC EHS Guidelines: Contaminated Land (2007) • GoN laws and regulations (Chapter 2 of IEE)	EPC Contractor Include in EPC contract cost Throughout construction	NEA PMU / PISC
		onsite, maximum reuse and recycling of waste by reputable, legitimate, licensed third parties and timely removal and safe transportation of unusable waste to a suitably licensed and engineered waste management facility with all waste transfer records retained. Keep copies of the waste management company's licenses on file. Document all volumes and types of wastes generated and removed off site (inert, solid, hazardous) using transfer • Leaving or disposing of construction wastes by burying them onsite or disposing of them at unlicensed waste management facilities is strictly prohibited. • Unsanitary open dumps are not to be used by the contractor or their third parties.			

		• Municipal waste collection systems must not be used as this is likely to mean that the waste is open dumped, arrangements should be made for direct disposal to a suitably licensed and engineered waste management facility with all waste transfer records retained. • Burning of waste on-site is also strictly prohibited. • No construction material or waste to be poured or thrown into drains • Provide regular training of staff in waste management issues.			

Topic	Impact / Issue	Commitment	Applicable Project Standards / Best Practice	Implementation Responsibility	Monitoring Responsibility
	All Components Recycling	• All recyclable waste (plastic, metal, paper, etc.) will be sorted on source and sent for recycling where facilities for recycling of these materials exist.		EPC Contractor Include in EPC contract cost Throughout construction	NEA PMU / PISC

	All Components Domestic and Inert Waste	• No domestic waste shall be left at work sites. • Any spoil material from tower or substation foundations will be removed from the site and sent to an appropriate state licensed waste management facility. • Ensure that wastes are not haphazardly dumped within the work sites and adjacent areas		EPC Contractor Include in EPC contract cost Throughout construction	NEA PMU / PISC
	All Components Hazardous Waste	Use containers suitable for each type of waste. Mark containers adequately specifying the waste types. Do not mix various waste streams. Remove waste at the completion of the work day and return it for storage at the appropriate Contractor facility before final disposal via a licensed contractor for hazardous waste removal and keep agreements with hazardous waste management company's active.		EPC Contractor Include in EPC contract cost Throughout construction	NEA PMU / PISC
	All Components Waste Tracking	Keep copies of waste manifests on site. Keep a record of waste on-site and waste removed.		EPC Contractor Include in EPC contract cost Throughout construction	NEA PMU / PISC

Noise and Vibration	TL, SS, DC and DRC Elevated noise levels and vibration	• Equipment and vehicles will be regularly maintained in accordance with the manufacturer's recommendations to help minimize noise emissions. • Only well-maintained modern equipment conforming with noise standards will be used at site. • Contractor to use suitably designed mufflers or sound reduction equipment on breakers/drills and ensure all leaks in the air line are sealed on them. • Work will be undertaken in daytime hours only – in accordance with IFC EHS definitions (7am – 10pm). • Unless in remote locations away from population installation works in the public domain and interacting with public roads or footpaths during 7am -10am as children are going to school and 3pm-5pm as they return back are to be avoided, especially near narrow roads where no safe alternative/diversion route is available for them. • If the works need to be undertaken during this time, then a safe and signed pedestrian diversion route must be put in place with a pedestrian marshal to ensure that children do not go near the working area and a flag man to control traffic if required to ensure children are not put at increased risk. • Noisy construction activity at substations (especially earthworks) only between the hours of 8 am - 6 pm except where no receptors in 500m. • Noise generating construction-related activities will be avoided during evenings, school hours, exam periods, prayer times, religious or cultural events near the sensitive receptors (within 500m). • No works on Sundays, holidays or festival days within 500m receptors. • Sensitive receptors within 500m to be consulted with any other special days when they would wish noise levels to be minimized. • Loud construction noise, breaking and drilling activities, must be limited to very short periods of activity adjacent to receptors to minimize disturbance.	• ADB SPS (2009) • IFC EHS Guidelines – Noise Management (2007) • IFC EHS Guidelines: Electrical Power and Distribution (2007) • GoN laws and regulations (Chapter 2 of IEE)	EPC Contractor Include in EPC contract cost Throughout project implementation	NEA PMU / PISC

		• On the boundary of the substation construction noise will be limited to 1- hour LAeq 70 dB(A). Construction noise experienced at rural residences must be limited to 45dB(A), other residences to 55dB(A), commercial buildings 65dB(A), and quiet areas 50dB(A) as 1hour LAeq – if nighttime work is permitted it must be limited to 40dBA in rural residences and quiet areas, 45dBA at other residences and 55dB(A) at commercial buildings as 1hour LAeq • If these noise levels are exceeded, or background levels >3dBA were already exceeded, the contractor will be required to implement additional noise mitigation measures such as adjusting working methods or placing of temporary noise barriers to ensure the noise standard is met. • No piling or blasting is to be undertaken for construction unless a piling/blasting management plan has been agreed. Any rock removal will be undertaken using pneumatic hammer (handheld or excavator mounted). • Use low noise generating equipment e.g., less than 55dBA sound pressure level at 1m. • The use of horns in areas where sensitive receptors are located (houses, schools, clinics, temples, etc.) will be prohibited. • Residents within 500m of substations will be forewarned of planned activities that are considered by the Project to be noisy (e.g., trench excavation / drilling). • If complaints are received from the local population regarding elevated noise levels, temporary noise screens shall be installed around the work site, shielding the identified receptors from the source of noise. In the event of a grievance being received carry out an investigation of noise levels to determine whether they will comply with permitted maximum levels using a hand-held noise monitor mounted on a tripod to measure IEC A-weighting dB(A) LAeq. • Construction workers exposure to noise should not exceed the levels set out in the General EHS Guidelines on Occupational Health and Safety otherwise the hearing protection is to be provided e.g., 85 dB(A) during continuation of 8 working hours without wearing PPE.			

Topic	Impact / Issue	Commitment	Applicable Project Standards / Best Practice	Implementation Responsibility	Monitoring Responsibility
Physical Cultural Heritage	TL, SS, DC and DRC Chance Finds	• Implement the chance find procedure, if required.	• ADB SPS (2009) • GoN laws and regulations (Chapter 2 of IEE)	EPC Contractor Include in EPC contract cost Throughout construction	NEA PMU / PISC
Utilities and Infrastructure	TL, SS, DC, DRC Outages, damage to utilities and private property	• All unanticipated damage to existing public utilities shall be restored immediately to pre-project condition and/or compensated at the cost of the contractor. • If existing structures (e.g., buildings) and roads, tracks, crops, or, canals, or drains are damaged by works, the Contractor will be required to rehabilitate them to at least their condition prior to construction works to the satisfaction of the property owner having reference to pre-condition surveys.	• ADB SPS (2009) • GoN laws and regulations (Chapter 2 of IEE)	EPC Contractor Include in EPC contract cost Throughout construction	NEA PMU / PISC
Occupational Health and Safety	All Components General	• For all construction works comply with GoN rules and regulations for the protection of workers. • Strictly implement all the measures outlined in annexes and all the measures outlined below. • Emergency contact number and details for medical, fire, etc. are to be displayed in all construction sites. • No unaccompanied members of the public shall be allowed on the construction site.	• ADB SPS (2009) • IFC EHS Guidelines General • IFC EHS Guidelines: Electrical Power Transmission and Distribution (2007) • ILO safety and health in construction • GoN laws and regulations (Chapter 2 of IEE)	EPC Contractor Include in EPC contract cost Throughout construction	NEA PMU / PISC
	All Components Fatalities	• In the event of any fatality occurring during the construction phase at any work site, provide NEA with the details of the fatality within one day (24 hours) of the event occurring in a Fatality Report (for onward reporting to ADB within 48 hours) and provide within 48 hours an incident report with corrective action detailing how reoccurrence will be prevented.		EPC Contractor Include in EPC contract cost Throughout construction	NEA PMU / PISC

	All Components Work sites	• Contractor is responsible for ensuring H&S of everyone on construction site including visitors and sub-contractor workers regardless they have been formally or informally employed. • Ensure adequate health and safety supervision is always on site (if staff temporarily off sick or on short term leave of less than a fortnight contractor to provide a named alternate in advance; if safeguard staff are on longer term leave, are posted elsewhere, or resign, contractor to ensure replacement CV is submitted to NEA in seven days of the contractor becoming aware with the staff joining the site within one month). • Construction plant and equipment used will be modern and fitted with appropriate safety devices. • • Temporary safety fences shall be erected around each work site. Require workers to confirm they have seen and • understood the requirements of the OHS plan before proceeding with the work. Warning signs will be displayed around work sites to warn • workers and members of the local community of potential risks in Hindi and other languages of the workers found on site. • • MSDS are to be readily available to any exposed workers and the first-aid personnel. All crews shall have a competent person responsible for first aid. Only allow suitably trained and qualified workers to be allowed to work on electrical equipment and at height, these workers • must have training record of attending suitable training course on electrical safety and working at height and have a recent medical checkup to confirm they are fit for work. • Require other workers to observe the minimum approach distances for excavations, tools, vehicles, pruning, and other activities when working around power lines. • Provide personal protective equipment (PPEs) for workers in accordance with national OHS regulations and good international industry practice. Handwashing facilities with clean running water supply and • soap as well as hand sanitizers and closed bins for disposal of hygiene related wastes to be provided on-site during works. Display posters to promote handwashing and respiratory hygiene etc. Sanitation and welfare facilities used by construction workers to be regularly cleaned and disinfected by the contractor.		EPC Contractor Include in EPC contract cost Throughout construction	NEA PMU / PISC

		• Enforce disciplinary system (e.g., immediate removal from site) for non-compliance with PPE requirements. • Ensure proper grounding and deactivation of live power lines during construction /decommissioning work or before any work near the lines and this will be checked and certified by Health and Safety Officer in advance. • Require workers to observe IFC EHS Guideline on T&D requirements for working at height. • During construction works ensure qualified first aider and trained fire marshal is always available on-site with an appropriately equipped first aid kit and appropriate fire extinguisher and other firefighting equipment immediately available for use. Every crew under one H&S supervisor shall have a first aid box at the worksite. • Since fuel, oil and chemicals will be handled on site provide emergency eye wash facilities adjacent to the storage facilities. • Arrange with nearest Health Center and/or Hospital for emergency cares of workers with an ambulance transport available on site or on immediate call. • Provide workers with access to an existing functional toilet facility (toilets and hand washing area) or provide a self-contained portable toilet with hand washing facilities (open defecation and use of pit latrines to be prohibited) generated wastewater to be disposed of to wastewater treatment plant. • Toilet facilities to be provided with adequate supplies of hot and cold running water, soap, and hand drying device. • Sufficient toilet facilities should be provided for the number of workers, and there should be an indication of whether the toilet facility is “in use” or “vacant” if not segregated. • Each transient work gang will always have with them on site canned drinking water - 4 liter per person per day, first aid kit and fire extinguisher (in case of forest fires) • Equipment used on or around the site will be modern and fitted with appropriate safety devices. • Ensure good housekeeping at construction site, storage areas, staff accommodation, etc. - to be kept neat and tidy, e.g., no materials, equipment, trash laying around, clean-up worksites so that they are free of debris on daily basis.			

		Use good means of communication during works in lines and checklists with triple signatories to confirm the deenergizing/energizing is completed			

	TL, SS, DC and DRC Working at height	• There must be a competent person present to supervise work at height and ensure that safety measures are being followed. • If working under live lines (HV or LV) then a safety scaffold will be installed so that the workers cannot come in contact with the OHL, with warning signs provided. There must be a competent person present to supervise work at height and ensure that safety measures are being followed. • Workers must be provided with adequate rest periods to avoid fatigue and must not be required to work at height during adverse weather conditions. First aid kit to include adequate ORS fluid/power packets.		EPC Contractor Include in EPC contract cost Throughout construction	NEA PMU / PISC
	All Components Food and drink	• Provide workers with access to clean eating area with supply of drinking water. • Adequate supplies of potable drinking water (at least 4 liters per person per day) meeting national standards should be provided to workers.		EPC Contractor Include in EPC contract cost Throughout construction	NEA PMU / PISC

	All Components Forced and Child Labor	• No forced or child labor to be employed in construction with the minimum age for employment on construction site to be 18 given hazardous nature of works involved. • Verifiable proof of age documentation is maintained for every worker. • Workers operate within the legal working hours and additional work hours are adequately compensated. • All overtime hours are voluntary; coercion, threats or penalties not used to pressure the workers into overtime. • Wages being paid to workers confirms to the minimum wage rated specified under applicable laws. • All wages including overtime are paid within legally defined time limits. • Pay statements shows earned wages, regular and overtime pay, bonuses and all relevant deductions • No unreasonable restraints on the worker's freedom of movement. • Terms of employment outlined at the time of recruitment do not differ from the terms offered during the course of employment.	• • ADB SPS (2009) ILO Convention - Minimum Age • Convention (1973) ILO Convention - Worst Forms of Child Labor Convention (1999) • ILO Convention – Forced Labour ILO safety and health in construction • • GoN laws and regulations (Chapter 2 of IEE)	EPC Contractor Include in EPC contract cost Throughout construction	NEA PMU / PISC
	All Components Labour and Accommodation Camps	• Ensure the camps established for providing accommodation to labors engaged in construction activities meet the requirements specified in the ILO safety and health in construction/worker accommodation guidelines and the requirements of the annex.	• ADB SPS (2009) • World Bank Guidance Note on • Managing Labor Influx, 2016 ILO safety and health in construction/worker accommodation guidelines • GoN laws and regulations (Chapter 2 of IEE)	EPC Contractor Include in EPC contract cost Throughout construction	NEA PMU / PISC

Community Health and Safey	<u>All Components</u> Grievances	• Implement the GRM procedures to provide opportunity for residents to raise concerns. • Provide 72 hours advance notice of any works (not including emergency works) to the local community.	• • •	ADB SPS (2009) Project GRM IFC EHS Guidelines: Community Health and Safety (2007) Voluntary Principles on Security and Human Rights[1]	EPC Contractor Include in EPC contract cost Throughout construction	NEA PMU / PISC
	<u>All Components</u> Hazardous Work Sites	• Robustly fence and sign immediate working area including stores/stockpiles with security presence to prevent public access during construction works. • Provide robust barricade/fence, hazard warning signage, and security presence whilst working in areas accessible to the • public. • Do not allow children to play in or adjacent to the construction site Do not leave hazardous conditions (e.g., unlit open excavations without means of escape) overnight unless no • access from the public can be ensured. Prevent standing water as it may become a breeding habitat for • mosquitoes etc. Construction site will be labeled / signposted in accordance with national regulations and GIIP to inform the public of the • specific safety risks. All work sites will be appropriately signposted and isolated (Through fencing or bunting) to prevent encroachment into these		GoN laws and regulations (Chapter 2 of IEE)	EPC Contractor Include in EPC contract cost Throughout construction	NEA PMU / PISC

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		areas. Where there are open excavations then solid fencing barrier must be used. • Safety scaffolds and safety nets will be used to protect pedestrians and vehicles (and the conductor itself) from potential injury/damage during conductor stringing – this will be used wherever stringing of OHL conductor crosses over roads, waterbodies, or nearby settlement presenting a possible risk to local communities. • Cut vegetation, excavated soil, poles and conductors, and other equipment will need to be stored outside of habitation, not block access or road use. • Contractors will be required to ensure that safe access ways to public and private amenities (including schools, public health centers, places of worship (temples) etc.) are maintained throughout the construction period. • In the urban areas and narrow roads transport equipment only during non-rush hours i.e., avoid the hours of 7 am to 10 am and 3 pm to 5 pm with the timing of works planned (taking in consideration school timings - going and coming back) in conjunction with other construction works to minimize the cumulative impacts they may cause traffic congestion. • In dense town areas or on busy roads or narrow roads installation works affecting roads to avoid rush hours (school timings) i.e., avoid the hours of 7am to 10 am and 3 pm to 5 pm • Stockpiling of materials, spoil, and any new equipment (cable reels etc.) only in designated areas where no access or road use (school gates) will be blocked. • Temporary pedestrian and traffic diversions are to be put in place per the approved traffic management plan. Diversion works to be			

		immediately dismantled on completion of works and the footpath and roads restored to their original condition. • Ensure that safe access ways to public and private amenities (including schools) are maintained, safe alternative routes provided and clearly signed where there are temporary diversions or blockages. • Safety guides should be provided where works are on footpaths or in locations of pedestrian crossings to help guide pedestrians, especially vulnerable persons, safely around the working area. • Safe access to property, footpaths and roads should be maintained and safe alternative routes and access provided and clearly signed where there are temporary diversions or blockages. • Damage to roads must be immediately repaired to ensure that local communities can continue to safely use the public roads/highways. • On completion of construction works roads must be left by the contractors in no poorer condition than when construction started. • For congested and narrow roads trained and experienced flagmen should be utilized to warn road users of the situation			
	All Components Record Keeping	• Keep a specific record of any community incidents that occur during the construction phase. Report the numbers to NEA monthly.		EPC Contractor Include in EPC contract cost Throughout construction	NEA PMU / PISC
	All Components Conflict with Security Personnel	• The project will implement the 'Voluntary Principles on Security and Human Rights' • During construction, due diligence will be applied to selection of security providers, rules of engagement will be devised, and training provided to all personnel. Performance will be monitored and audited periodically.		EPC Contractor Include in EPC contract cost Throughout construction	NEA PMU / PISC

Traffic Management	<u>All Components in the Public Domain</u> Traffic and Pedestrian Safety	• Implement agreed traffic management plan. Safe access to property and roads should be maintained and alternative routes and access provided where there are temporary diversions or blockages. Diversion works to be immediately dismantled on completion of works and the footpath and roads restored to their original condition. • Transport equipment only during non-rush hours i.e., avoid the hours of 9am to 11 am and 4pm to 6 pm to minimize traffic congestion. • Stockpiling of spoil and any new equipment (conductor reels, etc.) shall be away from properties and only in designated areas where no access or road use will be blocked. Allow for adequate traffic • flow around construction areas via diversions or temporary access roads. • Provide adequate traffic signs, appropriate lighting, well-designed traffic safety signs, barriers, and flag persons for traffic control. • Ensure that safe access ways to public and private amenities (including schools) are maintained, safe alternative routes provided and clearly signed where there are temporary diversions or blockages. • Traffic management will need to be done in consultation with the affected communities to ensure they are aware of likely disruption. • Implement traffic management controls during construction works with advance warning signs or flag persons to ensure health and safety of construction workers and road users. • Construction traffic warning signs will be positioned at road crossings and other appropriate locations as determined by the project, for example, along access routes before they are used by construction traffic. • Road safety and warning signs must be posted at 500m, 100m, and immediately in advance of the site entrance at least two days prior to the works commencing to inform the public of the temporary hazard of turning traffic. • For site entrances flagmen should be utilized to warn road users of the situation.	• ADB SPS (2009)	EPC Contractor Include in EPC contract cost Throughout construction	NEA PMU / PISC

Topic	Impact / Issue	Commitment	Applicable Project Standards / Best Practice	Implementation Responsibility	Monitoring Responsibility
Training	TL, SS, DC and DRC Pollution Prevention	• Conduct bi-monthly training of workers on pollution prevent control including good housekeeping and how to clean up oil/fuel spills and dispose of contaminated sorbent material which would be treated as a hazardous waste.	• ADB SPS (2009)	EPC Contractor	NEA PMU / PISC
	All Components OHS	• Conduct weekly training on occupational health and safety for all construction workers including refreshers. To include training for subcontractors before commencement of works.	• ADB SPS (2009)	EPC Contractor	NEA PMU / PISC
	All Components Emergency Response	• Conduct monthly training of workers on emergency preparedness and response procedures in case of an occupational or community health and safety incident during construction works. To include training for subcontractors before commencement of works.	• ADB SPS (2009)	EPC Contractor	NEA PMU / PISC
	TL, SS, DC and DRC Driver Training	• Driver training, monthly, to include advice on behaviors to reduce the potential for disturbance, including use of horn, loud radios with windows open, switching engines off when not in use, strictly observing speed limits and not accelerating or braking aggressively.	• ADB SPS (2009)	EPC Contractor	NEA PMU / PISC
GRM	All Components GRM Communication and Implementation	• Disseminate GRM contact details and arrangements to the community through the distribution of pamphlets, prominently posted notices at work sites, community centers etc. • Ensure that throughout construction highly visible signage providing their and GRM Focals names and contact details are prominently displayed at all construction sites, storage areas, temporary worker camps, subproject site offices, road crossing points etc. • To facilitate liaison with the local community the environment safeguards team will need to be supported by a member of staff who can speak the local language.	• ADB SPS (2009) • Project GRM	EPC Contractor	NEA PMU / PISC
		• Encourage affected persons to make use of the GRM yet clarify that this does not prevent them from pursuing legal action, if they feel that it is needed		EPC Contractor / NEA PMU	NEA PMU / PISC
		• Keep a record of all grievances received and their resolution and to report on them.		EPC Contractor	NEA PMU / PISC

Table 4: O&M EMP

Topic	Activity / Issue	Commitment	Applicable Pro / Standards Guidelines	Implementation Responsibility (Budget Source and Timing)	Monitoring Responsibility

Training/all components	OHS	• Ensure workers with a specific role have attended specialized health and safety trainings related that role e.g., health and safety stewards, first aiders, fire safety officers, as well as ensuring workers have received task-specific trainings for working with electricity, etc. • Only allow suitably trained and qualified workers to work on electrical equipment these workers must have training record of attending suitable training course on electrical safety and working at height and be provided with and wear the appropriate PPE for their role. • Untrained workers must not be permitted to work with live electricity.	• ADB SPS (2009)	NEA O&M team Throughout O&M phase	NEA PMU / PISC
	Emergency Response	• Conduct monthly training involving all workers on emergency preparedness and response procedures (drills) in case of an occupational or community health and safety incident during O&M including fire, natural disaster, disease outbreak etc. • Emergency preparedness and response training for operational management will include modules on first aid and fire safety including include training on how to use first aid and firefighting equipment provided onsite, and scenario of potential or confirmed infection.	• ADB SPS (2009)	NEA O&M team Throughout O&M phase	NEA PMU / PISC
	Pollution Prevention	• Conduct bi-monthly training of workers on pollution prevent control including good housekeeping and how to clean up oil/fuel spills and dispose of contaminated	• ADB SPS (2009)	NEA O&M team Throughout O&M phase	NEA PMU / PISC

		sorbent material which would be treated as a hazardous waste.			

Waste Management/ substations	General impacts	• Collect and segregate all O&M wastes including scrap metal, oil, and solid waste; ensure all workers are familiar with this segregation. Store all the wastes produced in an environmentally sound manner in designated, labelled area with separate waste containers (drums, bins, skips) for each type of waste with solid waste in enclosed bins to contain leachate and avoid vermin. Ensure that the waste hierarchy is followed including prevention, minimization, reuse and recycling -- maximum reuse and recycling of waste and timely removal of unusable waste according to national waste management regulations. • Encourage recovery of recyclable wastes that could be reused or sold to recyclers, rather than disposing of it. • Hazardous wastes (oily rags, etc.) must be disposed of using appropriately licensed waste management company. • Ensure sufficiently sized facilities are provided for the environmentally safe and sound collection, segregation and storage of waste (including from overnight accommodation) on-site, maximum reuse and recycling of waste by reputable, legitimate, licensed third parties and timely removal and safe transportation of unusable waste to a suitably licensed and engineered waste management facility with all waste transfer records retained. Keep copies of the waste management company's licenses on file. Document all volumes and types of wastes generated and removed off site (inert, solid, hazardous) using transfer • Municipal waste collection systems must not be used as this is likely to mean that the waste is open dumped, arrangements should be made for direct disposal to a suitably licensed and engineered waste management facility with all waste transfer records retained. Since it is unlikely any will be available locally use waste management facilities (e.g., compost, incineration) included on-site during the design stage.	• ADB (2009) • IFC Guidelines Waste Management (2007) • IFC Guidelines: SPS EHS Contaminated Land (2007) • GoN laws and regulations (Chapter 2 of IEE)	NEA Throughout O&M phase	NEA PMU / PISC
		• Burning of waste on-site is also strictly prohibited, including vegetation.			

		• Removal and disposal of identified invasive plant species in an ecologically sound manner.			
Health and Safety/all components	General	• NEA is responsible for ensuring H&S of everyone on construction site including visitors and sub-contractor workers regardless they have been formally or informally employed. • Strictly implement SOP and all health and safety measures in annex. • Warning signs will be displayed around work sites to warn workers and members of the local community of potential risks. • Maintain warning / advisory signs in good and visible condition. • Emergency contact number and details for medical, fire, etc. are to be displayed at the site. • For all maintenance works undertake risk assessment and prepare H&S plan in accordance with EHS Guidelines, considering occupational and community H&S and including adherence emergency preparedness and response plan with communication systems and protocols to report an emergency situation. Mitigation measures applicable to the construction stage are also applicable to O&M activities. • Enforce disciplinary system (e.g., immediate removal from site) for non-compliance with PPE requirements.	ADB SPS (2009) IFC EHS Guidelines General IFC EHS Guidelines: Electrical Power Transmission and Distribution (2007) GoN laws and regulations (Chapter 2 of IEE)	NEA Throughout O&M phase	NEA PMU / PISC

Topic	Activity / Issue	Commitment	Applicable Project Standards / Guidelines	Implementation Responsibility (Budget Source and Timing)	Monitoring Responsibility
	OHS	• Adequate supplies of potable drinking water meeting national standards should be provided to workers. • Sanitation and welfare facilities to be regularly cleaned and disinfected. • Handwashing facilities with clean running water supply and soap as well as hand sanitizers and closed bins for disposal of hygiene-related wastes to be provided on-site during works. • Display posters to promote handwashing and respiratory hygiene etc. • Arrange with nearest Health Center and/or Hospital for emergency cares of workers. • Maintain incident logbook and medical tests / health check-up of staff • Provide everyone who enters the substation with an OHS induction Only allow suitably trained and qualified workers to be allowed to work on electrical equipment and at height, these workers must have training record of attending suitable training course on electrical safety and working at height and have a recent medical check-up to confirm they are fit for work. • Require other workers to observe the minimum approach distances. • Provide personal protective equipment (PPEs) for workers in accordance with national OHS regulations and GIIP • Keep vents/windows unblocked and replace defunct bulbs/lights immediately • Ensure all substation workers receive basic first aid and firefighting training with annual refreshers • Ensure that at least one staff at substation is fully trained as a first aider and fire marshal			

		• During O&M works ensure qualified first aider and trained fire marshal is always available on-site with an appropriately equipped first aid kit and appropriate fire extinguisher and other firefighting equipment immediately available for use. • Maintain fully stocked, in-date first aid kit, keep first aid posters and emergency contact lists that are posted up to date • Maintain firefighting systems including in-date fire extinguishers and full sand buckets and keep fire safety posters up • Carry out regular inspections and periodic maintenance to ensure electrical standards are being upheld • Display clear emergency exits signs (in working order, if light signs, ensure they work) and keep exits clear of any blockages. Remove any trip hazards on the ground, e.g., materials, equipment, trash laying around. • Undertake regular pest control using integrated pest management approach • Maintain vegetation at the substation that poses a health and safety hazard • Cleaning of toilets on daily basis, use of disinfectant and floor cleaners; keep toilets/septic tank/soakaway maintained • Measure exposure levels to electromagnetic fields (EMF) and provide workers working in zones where EMF levels are above reference levels with personal EMF monitoring device to be attached onto their PPE. • Periodic spot monitoring using mobile phone app of noise levels and ambient EMF for substations at the boundary fence/near transformers to ensure they are below the occupational/community noise levels and ICNRP occupational/community EMF exposure levels • Maintain security and prevent entry by the local community and livestock by maintaining adequate boundary fencing or wall, always keeping control			

		room doors and gates shut, and having security persons present 24x7 to prevent unauthorized public access and trespass.			

		• NEA in conjunction with local municipalities, village heads, and the media with the support of CSOs to continue to organize health and safety campaigns on electrical safety community awareness raising activities in local communities and schools within 500 m of the substations			
	Fatalities	• In the event of any fatality occurring during the O&M phase at any work site, provide PMU with the details of the fatality within one day (24 hours) of the event occurring in a Fatality Report (for onward reporting to ADB within 48 hours) and provide within 48 hours an incident report with corrective action detailing how reoccurrence will be prevented.		NEA Throughout O&M phase	NEA PMU / PISC

Appendix 2: Environmental Monitoring Plan

Table 1. General Environmental Monitoring Plan (EMoP) for all Project Components DRC

Project Activity or Environment Impacts/ Risks	Monitoring Parameters	Method of Monitoring including Standards/ Guidelines	Frequency and Timing	Location/ Components	Performance Indicator	Implementation	Supervision (NEA PMU)
Pre-construction							
Statutory Clearances	Licenses / Permits and Insurances	Review of all applicable clearances, licenses, permits and insurances before the start of construction	One time prior to the start of construction	In general, for all project components	All relevant permits, licenses and insurances outlined in the IEE are obtained prior to the start of works.	EPC contractor to undertake monitoring and report to NEA in monthly and quarterly reports with copies attached.	Review all clearances, licenses, permits and insurances and document compliance in EMR
Staffing	**Contractors environmental, social, health and safety staff**	Review of staff contracts, timesheets and payslips	Prior to the start of construction then periodically throughout construction	In general, for all project components	All staff outlined in the IEE are in place at the start of construction and are on site for the allotted periods specified in the EMP	EPC contractor to undertake monitoring and report to NEA in monthly and quarterly progress reports with evidence attached.	Review contracts, timesheets and payslips and document compliance in EMR

Training and Inductions	Training records	Review of all induction training records, including training materials, attendance sheets and photographs. Attendance at sample of sessions and randomized sample of people on site to assess if they have received training and induction.	One time prior to the start of construction. Then periodically through construction to ensure new staff have received induction training and refreshers are being delivered.	In general, for all project components	All people on-site whether formally or informally employed have received the required training and induction.	EPC contractor to undertake monitoring and report to NEA in monthly and quarterly progress reports with evidence attached.	Review all training and induction records, attendance at sample of sessions, sample of people on site and document compliance in EMR
Community Awareness	Pre-construction and pre-operation awareness documents	Review documents prepared for community awareness activities, attendance sheets and photographs of meetings held to deliver them. Randomized sample of residents to assess if they have received any awareness materials	One time prior to the start of construction and again during commissioning prior to operation	In general, for all project components	Awareness documents completed and distributed to adjacent villages within 500m	EPC contractor to undertake monitoring and report to NEA in monthly and quarterly progress reports with evidence attached.	Review awareness documents, attendance at sample of sessions held, conduct sample of residents and document compliance in EMR
Labor Camps and Overnight Accommodation, Sanitation and Welfare Facilities	GON legislation, ILO Safety and Health in construction and guidance on worker accommodation, and IOM migrant workers accommodation checklist	Inspection audit of labor camps and overnight accommodation by labor staff.	Prior to the start of construction then periodically throughout construction	For all project components, all labor camps and overnight accommodation areas as well as day rest areas	Labor camps and overnight accommodation are compliant with EMP requirements, GON legislation, ILO guidance and IOM checklist	EPC contractor to undertake monitoring and report to NEA in monthly and quarterly progress reports with their labor officer's inspection audit and other evidence attached.	Review of contractor's audit, inspection audit by PISC labor expert, and document compliance in EMR

Health and Safety	Health and Safety Risk Assessment, Incident Reporting	Review of risk assessment and incident reporting system including GRM,	Prior to the start of construction then periodically	For all project components, all construction areas	Risk assessment completed, system established, and	EPC contractor to undertake monitoring and	Review of contractor's system and audit,
	System including labor GRM and H&S provisions	inspection audit of H&S provisions by H&S safeguard staff	throughout construction	and related facilities, labour camps and overnight accommodation areas etc.	contract is fully compliance with EMP requirements, GON legislation, IFC EHS Guidelines and ILO Safety and Health in Construction	report to NEA in monthly and quarterly progress reports with evidence attached including H&S officer's checklists etc.	inspection audit by PISC environment expert and document compliance in EMR
Construction including Site Establishment, Preparation and Clearance Works and Commissioning Activities							

Health and Safety – incidents	Records of health and safety incidents	Keep records of near miss, minor, lost time, and fatal health and safety incidents related to the project, compile records from construction sites into a database for tracking. Carry out randomized interviews with workers and the community to identify if any unrecorded incidents occurred.	Ongoing with of Monthly Compilation Records	For all project components, all construction areas and related facilities, labour camps and overnight accommodation areas etc. Offsite traffic incidents related to contractor's vehicles or the condition of access roads to site	Zero lost time incidents or fatalities (among workers and community) For 100% lost time incidents or fatalities immediate action taken to avoid repeat or escalation of situation All incidents including minor and near miss dealt with in accordance with EMP/CSEMP with lessons learnt for future 100% lost time and fatalities reported to NEA within 24 hours and ADB within 48 hours with incident report submitted within 48 hours with root cause analysis and corrective action taken.	EPC contractor to undertake monitoring and report to NEA in monthly and quarterly progress reports with records and reports attached.	Check monitoring being undertaken, review records and reports, conduct interviews with workers and the community and document compliance in EMR

Project Activity or Environment Impacts/ Risks	Monitoring Parameters	Method of Monitoring including Standards/ Guidelines	Frequency and Timing	Location/ Components	Performance Indicator	Implementation	Supervision (NEA PMU)
Water resources	Water volume used and source	Keep records of all water used (volume in m^3) and source. Carry out randomized interviews with the community to identify if any unrecorded grievances occurred.	Ongoing with of Monthly Compilation Records	For TL, SS, DC and DRC, all construction areas and related facilities, labour camps and overnight accommodation areas etc.	Water use documented. No grievance received during construction or operation regarding conflict with other water users	EPC contractor to undertake monitoring and report to NEA in monthly and quarterly progress reports with records and evidence provided.	Check monitoring being undertaken, review records, conduct interviews with the community and document compliance in EMR
Soil (earthworks)	Volume of soil disturbed during construction	Keep records of earthworks involved, including total volume in m^3 of soil excavated and reused (any disposed of as spoil off site to licensed waste disposal facilities recorded as per waste generation) Carry out visual inspection and randomized interviews with community to identify if any unrecorded grievances occurred	Ongoing with of Monthly Compilation Records	For TL, SS, DC and DRC, construction sites involving earthworks/cut and fill activities	Earthworks documented, and all excavated and cut and fill volumes accounted for, either reused on-site or disposed of off-site to licensed waste disposal facilities with no grievance received related to spoil disposal unresolved.	EPC contractor to undertake monitoring and report to NEA in monthly and quarterly progress reports with records and evidence provided.	Check monitoring being undertaken, review records, conduct Inspection and interviews with the community and document compliance in EMR

Hazardous materials– incidents	Pollution incidents	Records of pollution incidents (e.g., type of material spilled, amount in kg or $m^{3,}$ and action taken to clean up) Carry out visual inspection and interviews with workers and the community to identify if any unrecorded incidents occurred	Ongoing with Monthly Compilation of Records	For TL, SS, DC and DRC, all construction areas and related facilities, labour camps and overnight accommodation areas etc.	Zero major incidents occurred. Minor incidents responded to in accordance with EMP/CSEMP with lessons learnt for future.	EPC contractor to undertake monitoring and report to NEA in monthly and quarterly progress reports with records and reports attached.	Check monitoring being undertaken, review records and reports, conduct Inspection and interviews with the workers and community and document compliance in EMR
Natural Resource Use (Construction Materials) and Waste Generation	Volume of construction materials used, and waste generated, and disposal route	Keep records of all types of materials used and wastes produced by type, volume/ weight. Document waste disposal through transfer notes including type, volume/ weight, transport provider, intermediaries if any and final treatment or disposal facility (with its license and capacity) Carry out visual inspection and randomized interviews with community to identify if any unrecorded grievances occurred	Ongoing with of Monthly Compilation Records	For all project components, all construction areas and related facilities, labour camps and overnight accommodation areas etc.	Transfer of 100% of construction wastes documented, and all wastes disposed of in an environmentally safe and sound manner in accordance with the EMP/CSEMP and IFC General EHS Guidelines with no grievance received related to waste disposal unresolved	EPC contractor to undertake monitoring and report to NEA in monthly and quarterly progress reports with records and other evidence provided.	Check monitoring being undertaken, review records, conduct Inspection and interviews with the community and document compliance in EMR

Wildlife	Animal casualties	Keep written record, supported by photographs, of any animal conflicts or casualties, including a cause of death if known Carry out visual inspection and randomized interviews with workers and community to identify if any unrecorded grievances occurred	Ongoing with of Monthly Compilation Records	For TL, SS, DC and DRC, construction site, including temporary construction facilities. Offsite traffic incidents related to the contractor's vehicles or the condition of village roads used for access	Zero fatal animal casualties occurred For 100% incidents immediate action taken per wildlife encounter protocol and GON legislation and to avoid repeat or escalation of situation All incidents including minor and near miss dealt with in accordance with EMP/CSEMP with lessons learnt for future	EPC contractor to undertake monitoring and report to NEA in monthly and quarterly progress reports with records and reports attached.	Check monitoring being undertaken, review records and reports, conduct inspections and interviews with the community and document compliance in EMR
Employment	Records of all construction workers including subcontractor workers whether formally or informally employed and including any daily labor	Keep records of employment generated, age/gender/sex-disaggregated employment data, home locations, medical checks, if labor accommodation provided, and trainings and inductions received Carry out visual inspection and randomized interviews with workers to identify if any unrecorded grievances occurred	Ongoing With Monthly Compilation Records	For all project construction site	Employment in accordance with EMP/CSEMP plus GON legislation; no grievance received related to employment of workers unresolved	EPC contractor to undertake monitoring and report to NEA in monthly and quarterly progress reports with records and other evidence provided.	Check monitoring being undertaken, review records, conduct Inspections and interviews with workers and document compliance in EMR

Project Activity or Environment Impacts/ Risks	Monitoring Parameters	Method of Monitoring including Standards/ Guidelines	Frequency and Timing	Location/ Components	Performance Indicator	Implementation	Supervision (NEA PMU)
Climate change emissions	SF6 used and leakage rates	Keep records of SF6 total volume used in SS installation and leakage rates	Ongoing with Monthly of Compilation Records	Substations	EMP compliance: significantly less than 0.1% leakage rate	EPC contractor to undertake monitoring and report to NEA in monthly and quarterly progress reports with records attached	Check monitoring being undertaken, review records, and document compliance in EMR
Drinking water supplies	GON drinking water standards	Drinking water tests from supplier Carry out visual inspection and randomized interviews with workers to identify any unrecorded grievances	Ongoing with Monthly of Compilation Records	For all project components, sources of drinking water for construction for which supplier can provide copies of drinking water tests to confirm compliance.	GON drinking water parameters	EPC contractor to undertake monitoring and report to NEA in monthly and quarterly progress reports with records and test reports attached.	Check monitoring g being undertaken, review records, conduct inspections and interviews with workers and document compliance in EMR
O&M							
Climate change emissions	SF6 used and leakage rates	Keep records of SF6 total volume used and leakage rates	Ongoing with Monthly of Compilation Records	Substations	EMP compliance: significantly less than 0.1% leakage rate	NEA O&M team to undertake monitoring and report to PMU in	Check monitoring being undertaken, review records, and document

Project Activity or Environment Impacts/ Risks	Monitoring Parameters	Method of Monitoring including Standards/ Guidelines	Frequency and Timing	Location/ Components	Performance Indicator	Implementation	Supervision (NEA PMU)
						monthly and quarterly progress reports with records attached	compliance in EMR
Drinking water supplies	GON drinking water standards	Drinking water tests from supplier Carry out visual inspection and randomized interviews with workers to identify any unrecorded grievances	Ongoing with Monthly of Compilation Records	SS, DC and DRC sources of drinking water for operation for which supplier can provide copies of drinking water tests to confirm compliance.	GON drinking water parameters	NEA O&M team to undertake monitoring and report to PMU in monthly and quarterly progress reports with test reports attached	Check monitoring being undertaken, review records, conduct inspections and interviews with workers and document compliance in EMR

Environment, Health and Safety Codes of Practice

ENVIRONMENT

The national laws and regulations and IFC EHS guidelines should be followed along with the following environmental guidance:

Pollution Prevention

Air Pollution (Dust)

- Use of modern equipment, exclude over-aged or worn-out equipment or vehicles from the construction site
- Trucks importing loose raw materials or removing spoil must be covered with tarpaulin to reduce dust generation
- Position any stationary emission sources (e.g., water pumps, diesel generators, compressors, etc.) as far as practical from the nearest properties
- Impose speed limits on construction vehicles on off- and on-site access roads to minimize exhaust and dust emissions especially where access roads run adjacent to properties.
- Prohibit engine idling.
- Stockpiles of spoil and other dust generating materials to be kept to a minimum necessary to undertake works for the day and covered with tarpaulin.
- Minimize double handling and drop loads.
- Cover exposed soil with materials like gravel to minimize re-suspension of dust.
- Sprinkle earthworks, off- and on-site access roads that are not blacktopped, and material stockpiles with water during the construction period to avoid dust being dispersed by wind and mitigate dust related issues due to frequent movement of construction vehicles as necessary i.e., 2-3 times per day but more often if needed during excavations, dry and windy conditions that enable dust to be easily mobilized and the dust to be visible.
- Regularly clean dust from the off-site access roads during and immediately after construction work is completed.
- Strictly prohibit the burning of wastes generated by project-related activities.
- Ensure workers working near or having long exposure to vehicle exhausts and earthworks are provided with clean N95 dust masks to avoid inhalation or particulate matter and other pollutants.
- Periodic medical respiratory checks to be performed on workers exposed to high dust levels.

Noise and Vibration

- Use of modern equipment, exclude over-aged or worn-out equipment or vehicles from the construction site
- Select construction techniques and low noise generating equipment e.g., less than 55 dBA sound pressure level at 1m, and stage noisy works to limit their duration to minimize noise and vibration
- Fit all equipment and vehicles used in construction with exhaust silencers where the manufacturer's design allows this
- Position any stationary emission sources (e.g., water pumps, diesel generators, compressors, etc.) as far as practical from the nearest properties
- Prohibit engine idling .
- Prohibit use of horn by construction vehicles
- Impose speed limits on construction vehicles on off- and on-site access roads to minimize noise emissions especially where access roads run adjacent to properties
- Provide appropriate PPE (acoustic ear plugs or earphones capable of reducing noise levels to 80 dB(A) for hearing protection) to any workers subjected to noise levels of 80 dBA for more than 8 hours per day and ensure they wear it e.g., if piling etc.
- No unprotected ear should be exposed to a peak sound pressure level (instantaneous) of more than 140 dB(C) or average maximum sound levels of 110 dB(A).
- Periodic medical hearing checks to be performed on workers exposed to high noise levels of 80 dBA for more than 8 hours per day.

Soil and Water Pollution

- Avoid storage of all fuel, oil, and chemicals in areas located within 100m of surface water and groundwater springs, etc. to avoid direct contamination or contamination through run off
- Drums, containers or tanks of fuel, oil, or chemicals to be labelled and kept in a designated, labelled storage area under lock and key when not in use

•Establish dedicated fuel, oil, and chemicals stores (drums/containers/tanks) on impermeable bunded area of 110% volume to avoid spills and leaks contaminating soil and affecting water quality
•Secondary containment design to also consider means to prevent contact between incompatible materials in the event of a release.
•Place all drums or containers of fuel, oil, or chemicals on drip trays it not sited on impermeable surface with 110% bunded capacity.
•Place all equipment that containing fuel or oil on drip trays it not sited on impermeable surface with 110% bunded capacity.
•Undertake refilling or refueling only on areas of hard protected soil, preferably bunded, at least 100m from surface water with all drainage directed through oil interceptors.
•Provide drip trays/catch basins or other overflow/drip containment measures at connection points or possible overflow locations during refilling or refueling
•Use of dripless hose connections for vehicle tanks and fixed connections with storage tanks
•Use dedicated fittings, pipes, and hoses on containers or tanks and regularly inspect their condition
•Use of refilling or refueling equipment that is compatible and suitable for the characteristics of the materials being transferred and designed to ensure safe transfer
•Overfills of drums, containers, and tanks to be prevented as they are among the most common causes of leaks and spills resulting in soil and water contamination, this can be achieved by:
-Checklist of measures to follow during filling operations
-Provision of automatic fill shutoff valves to prevent overfilling
-Installation of gauges on containers or tanks to measure volume inside
-Use of pipe connections with automatic overfill protection (float valve)
-Pumping less volume than available capacity by ordering less material than its available capacity
•Provision of overfill or over pressure vents that allow controlled release to a capture point
•Maintain procedures to prevent hazardous materials from being stored in incorrect containers or tanks
•Provide spill response kit with sufficient absorbent materials (e.g., sorbents, dry sand, sandbags) on-site for immediately soaking up any fuel, oil, or chemical leaks/spills that do accidentally occur
•Undertake construction during the dry season to minimize exposed areas subject to erosion by surface water runoff and to avoid flood risk, leading to accidents and/or water contamination.
•Deep excavations to be limited to dry season to prevent the need to pump out and dispose of sediment laden water.
•Works over or near watercourses will adopt protection measures to guard against loss of soil that would result in the turbidity of water.
•Implement measures to prevent landslides to avoid contamination of rivers by soil.
•Minimize soil erosion and surface water runoff by reducing the extent of earthworks, revegetating earthworks on completion, and covering stores of sand and spoil with tarpaulin
•Ensure surface water runoff from the construction site shall not discharge directly to surface water but shall be discharged through sedimentation basin and oil interceptor.
•Provision of oil-water separator on all drainage systems
•If water from excavations is pumped it must be disposed of via a sedimentation basin, it must not be disposed of directly to surface water.
•Do not allow washing of equipment or vehicles in surface water and ensure all washing water is discharged to sedimentation basin and oil interceptor instead of directly to surface water.
•Provision of designated hard standing areas for equipment servicing, refueling and wash down located at least 100m from surface water bodies, groundwater springs, with drainage directed through oil and grease interceptors before discharge into a settling pond
•Cement will be stored in enclosed storage facilities and not exposed to the elements.
•Do not undertake any concrete mixing within 100m of surface water
•Strict prohibition on open defecation and urination by construction workers
•No use of pit latrines
•Toilets and washing facilities to be connected to septic tank (with soak pit)
•No untreated wastewater is to be discharged direct to surface water or the ground
•Spent engine oil from the equipment will be collected and sent for recycling and re-use.

Materials and Waste Management

•Import all materials from existing licensed sources and keep records of all materials used, and sources.
•Storage yards will be fenced using a solid fence to catch windblown material.

•Minimize waste generation, restrict use of plastics and polyethene and use recyclable/biodegradable materials during construction to the extent possible
•Use durable, long-lasting materials that will not need to be replaced as often, thereby reducing the amount of construction waste generated over time.
•Purchase perishable construction materials e.g., paints incrementally to reduce spoilage of unused materials.
•Use building materials that have minimal packaging to avoid generation of excessive packaging waste
•Use construction materials containing recycled content when possible and in accordance with technical standards
•Prior to the start of works the contractor will ensure the waste management system is established at the construction sites and workers camps.
•Separate waste containers (drums, bins, skips or bags) will be provided for different types of waste; prevent the commingling or contact between incompatible wastes and allow for inspection between containers to monitor leaks or spills
•Sensitize workers on good housekeeping and the environmentally sound storage and disposal of construction and wastes, and importantly not to leave garbage lying around.
•Collect and segregate construction wastes including scrap metal, oil, and solid waste; ensure all workers are familiar with this segregation and arrange garbage bins to collect these wastes so they are not thrown on the floor
•Clearly identifying (label) and demarcating the waste storage area(s) on a site plan
•Store all the wastes produced in an environmentally sound manner in designated, labelled area with separate waste containers (drums, bins, skips or bags) for each distinct type of waste.
•Store solid waste in enclosed bins to contain leachate and avoid vermin.
•Store hazardous waste so as to prevent accidental releases to air, soil, and water resources in closed containers away from direct sunlight and rain
•Limiting access to hazardous waste storage areas to workers who have received proper training
•Secondary containment systems to be constructed using materials appropriate for the wastes being contained
•Provide adequate ventilation where volatile wastes are stored
•Conducting periodic inspections of waste storage areas and documenting the findings
•Encourage recovery of recyclable wastes that could be reused or sold to licensed recyclers, rather than disposing of it.
•Prohibit use of waste (e.g., empty cement bags and containers, plastic, wooden planks) for backfilling – only inert spoil may be used for backfilling to avoid need for off-site disposal (any excess inert spoil is to be disposed of at suitably licensed waste facilities).
•Prohibit burning of construction wastes.
•Prohibit dumping of construction wastes on-site, into streams, in agricultural fields etc.
•Provide weekly toolbox talk to remind of the importance of waste disposal, prohibition of disposal on the road, in drains etc., prohibition on burning of wastes, and open defecation and urination.
•Develop a procedure/system to penalize through escalating fines or similar any construction workers who breach these requirements.
Document all wastes removed off site (including excavated soil, solid and hazardous waste) using transfer notes, to be taken by licensed waste contractors who should reuse/recycle or dispose of the waste to suitably licensed and engineered waste management facilities according to type
•Excavated spoil that cannot be reused to a licensed disposal site as suitable for accepting inert wastes ensuring no solid or hazardous wastes are comingled with the inert excavated spoil
•Collect solid waste and dispose of it to suitably engineered and licensed sanitary waste facilities
•Ensure any hazardous waste such as oily rags or old drums disposed of in suitably licensed hazardous waste facilities
•Waste containers designated for off-site shipment to be secured and labelled with the contents and associated hazards, be properly loaded on the transport vehicles before leaving the site, and be accompanied by a shipping paper, that describes the load and its associated hazards

Emergency Preparedness and Response Planning

1. For spills and leaks an emergency preparedness and response plan tailored to the hazards associated with the project, should include:

•SOP for the management of containment structures, specifically the removal of any accumulated fluid, such as rainfall, to ensure that the intent of the system is not accidentally or willfully defeated
•Implementation of inspection programs to ensure containment structures are physically intact and being well managed
•Identification of locations of hazardous materials and associated activities on an emergency plan

•Documentation of availability of specific personal protective equipment and training needed to respond to an emergency
•Documentation of availability of spill response equipment sufficient to handle at least initial stages of a spill and a list of external resources for equipment and personnel, if necessary, to supplement internal resources
•Description of response activities in the event of a leak, spill, release, or other emergency including internal and external notification procedures, specific responsibilities of individuals, decision process for assessing severity of the incident and determining appropriate action, first aid and emergency medical treatment, evacuation routes, post-event activities such as clean-up and disposal, incident investigation, worker re-entry, and replenishment of used PPE and spill response equipment
•Inspecting, testing, and maintaining the emergency response equipment
•Training of workers on release prevention, including drills specific to hazardous materials stored on site

Soil Erosion and Runoff Management

2. Bunding is an engineering soil conservation measure used for creating obstruction to the surface water runoff for controlling soil erosion. By bunding, an area is divided into smaller parts; thereby the effective slope length is reduced. The reduction of the slope length causes a reduction of the soil erosion as the surface runoff water is retained in the bund. Bunds are simple earthen embankments of varying lengths and heights, constructed across the slope. Graded bunds are adopted in case of high or medium annual rainfall (>600 mm) and relatively less permeable soil areas and in cases such as a construction site where the water ponded behind the bund is to be removed.
3. Construction of three-stage sedimentation ponds/tanks with an inlet, mid, and outlet section is required to allow sediment to settle out of surface water runoff before release of water. Silt fences can be used to channel surface water runoff to the sedimentation pond/tank. The working volume of the sedimentation pond/tank must be sufficient to allow for a minimum hydraulic retention time of at least 120 minutes under the peak surface water runoff conditions. If runoff rates exceed the capacity of a sedimentation pond/tank, one or more additional sedimentation ponds/tanks will be needed in parallel to accommodate the higher flow rates. Maximum sediment accumulation in the sedimentation pond/tank must be 25% or less.

HEALTH AND SAFETY

The national laws and regulations, IFC EHS guidelines, ILO safety and health in construction should be followed along with the following safety guidelines:

a. Preventive and protective measures should be introduced according to the following order of priority:

- Eliminating the hazard by removing the activity from the work process.
- Controlling the hazard at its source through use of engineering controls.
- Minimizing the hazard through design of safe work systems and administrative or institutional control measures.
- Providing appropriate personal protective equipment (PPE) in conjunction with training, use, and maintenance of the PPE.

b. OHS Training

- Training should generally be provided to management, supervisors, workers, and occasional visitors to areas of risks and hazards.
- Provisions should be made to provide OHS orientation training to all new employees to ensure they are apprised of the basic site rules of work at / on the site and of personal protection and preventing injury to fellow employees.
- Training should consist of basic hazard awareness, site- specific hazards, safe work practices, and emergency procedures for fire, evacuation, and natural disaster, as appropriate.

- Any site-specific hazard or color coding in use should be thoroughly reviewed as part of orientation training.

c. Basic OHS Training

- A basic occupational training program and specialty courses should be provided, as needed, to ensure that workers are oriented to the specific hazards of individual work assignments.
- Workers with rescue and first-aid duties should receive dedicated training so as not to inadvertently aggravate exposures and health hazards to themselves or their co- workers. Training would include the risks of becoming infected with blood–borne pathogens through contact with bodily fluids and tissue.
- Through appropriate contract specifications and monitoring, the contractor should ensure that service providers, as well as contracted and subcontracted labor, are trained adequately before assignments begin.

d. Tool Box Talks:

- Tool Box Talk meetings to be conducted every day before starting of the work. Work Plan for the day along with hazards/risks involved in the activities and safe working practices for the same are to be discussed with the workers, these can be conducted by contractor ‘s supervisory staff as well.
- Record of the Tool Box Talk meeting to be generated and signature of all the workers/supervisor are to be taken on the meeting sheet. This activity will gradually enhance the safety awareness and will also help in operating in a planned manner.

e. Labelling

All vessels that may contain substances that are hazardous as a result of chemical or toxicological properties, or temperature or pressure, should be labeled as to the contents and hazard, or appropriately color coded.

f. Noise

- No employee should be exposed to a noise level greater than 85 dB(A) for a duration of more than 8 hours per day without hearing protection. In addition, no unprotected ear should be exposed to a peak sound pressure level (instantaneous) of more than 140 dB(C).
- The use of hearing protection should be enforced actively when the equivalent sound level over 8 hours reaches 85 dB(A), the peak sound levels reach 140 dB(C), or the average maximum sound level reaches 110dB(A). Hearing protective devices provided should be capable of reducing sound levels at the ear to at least 85 dB(A).
- Although hearing protection is preferred for any period of noise exposure in excess of 85 dB(A), an equivalent level of protection can be obtained, but less easily managed, by limiting the duration of noise exposure. For every 3 dB(A) increase in sound levels, the ‘allowed’ exposure period or duration should be reduced by 50 percent.
- Prior to the issuance of hearing protective devices as the final control mechanism, use of acoustic insulating materials, isolation of the noise source, and other engineering controls should be investigated and implemented, where feasible

g. Electricity

- Marking all energized electrical devices and lines with warning signs
- Checking all electrical cords, cables, and hand power tools for frayed or exposed cords and following manufacturer recommendations for maximum permitted operating voltage of the portable hand tools
- Double insulating/grounding all electrical equipment used in environments that are, or may become, wet; using equipment with ground fault interrupter (GFI) protected circuits

- Appropriate labelling of service rooms housing high voltage equipment ('electrical hazard') and where entry is controlled or prohibited
- Conducting detailed identification and marking of all buried electrical wiring prior to any excavation work

h. Training and licensing industrial vehicle operators in the safe operation of specialized vehicles such as forklifts, including safe loading/unloading, load limits

- Ensuring drivers undergo medical surveillance
- Ensuring moving equipment with restricted rear visibility is outfitted with audible back-up alarms
- Establishing rights-of-way, site speed limits, vehicle inspection requirements, operating rules and procedures, and control of traffic patterns or direction
- Restricting the circulation of delivery and private vehicles to defined routes and areas, giving preference to 'one-way' circulation, where appropriate

i. Fall prevention and protection measures should be implemented whenever a worker is exposed to the hazard of falling more than two meters. Fall prevention may include:

- Installation of guardrails with mid-rails and toe boards at the edge of any fall hazard area
- Proper use of ladders and scaffolds by trained employees
- Use of fall prevention devices, including safety belt and lanyard travel limiting devices to prevent access to fall hazard area, or fall protection devices such as full body harnesses used in conjunction with shock absorbing lanyards or self- retracting inertial fall arrest devices attached to fixed anchor point or horizontal lifelines
- Appropriate training in use, serviceability, and integrity of the necessary PPE
- Inclusion of rescue and/or recovery plans, and equipment to respond to workers after an arrested fall

j. Fires and or explosions resulting from ignition of flammable materials or gases can lead to loss of property as well as possible injury or fatalities to project workers. Prevention and control strategies include:

- Storing flammables away from ignition sources and oxidizing materials.
- Defining and labeling fire hazards areas to warn of special rules (e.g. prohibition in use of smoking materials, cellular phones, or other potential spark generating equipment);
- Providing specific worker training in handling of flammable materials, and in fire prevention or suppression

k. **Personnel Protective Equipment**

- Risks to the health and safety of workers can be prevented by provision of Personal Protective Equipment (PPEs) to all workers. Personal protective equipment like safety gloves, helmet, mufflers etc. will be provided during the construction period and during the maintenance work. This will be included in the BOQ list. Depending on the nature of work and the risks involved, contractors must provide without any cost to the workers, the following protective equipment. The list of protective equipment is given in Table 1.
- Helmet shall be provided to all workers, or visitors visiting the site, for protection of the head against impact or penetration of falling or flying objects.
- All PPE must be of good quality with mark of quality standard certification.
- Safety belt shall be provided to workers working at heights for bridge construction, etc.
- Safety boots shall be provided to all workers for protection of feet from impact or penetration of falling objects on feet.
- Ear protecting/ earmuffs/plugs shall be provided to all workers in high noise zones.
- Eye and face protection equipment shall be provided to all welders to protect against sparks.
- Respiratory protection devices shall be provided to all workers during occurrence of fumes, dusts, or toxic gas/vapor.

- The supervisor must ensure that appropriate personal protective equipment is available to workers; properly worn when required and properly cleaned, inspected, maintained and stored.
- A worker shall be responsible for using the items of personal protective equipment provided by the employer;
- A worker who is required to use personal protective equipment must-
- Use the equipment in accordance with training and instruction.
- Inspect the equipment before use.
- Refrain from wearing protective equipment outside of the work area which if done so would constitute a hazard; and
- Report any equipment malfunction to the supervisor or employer.
- A worker who is assigned responsibility for cleaning, maintaining or storing personal protective equipment must do so in accordance with training and instruction provided.
- An emergency procedures manual will be kept.
- First aid facilities will be made available on-site and doctors called in from nearby village/towns when necessary. Minimum contents of the first aid box is given in Table 2.

Table 1 - Personnel Protection Equipment (PPE) for safety of different body parts

No.	Body Part to be Protected	PPE
1	Head	Safety helmet, hard hat, Crash helmets
2	Eye	Eye protectors, eye protectors for radiations, shield and helmet, zero power goggles
3	Ear	Earplug, earmuffs
4	Noise-Mouth	Du respirator, gas mask, self-contained breathing apparatus, dust masks
5	Hand	Standard work gloves, cutting gloves, leather work gloves, heat protective gloves, anti-vibration gloves
6	Foot	Industrial safety boots, chemical-proof boots
7	Body	Standard work clothing, chemical-proof clothing, heat protective clothing, leather apron
8	Others	Safety belts, personal protective equipment for radiation protection, back support belts
9	Communicable diseases	Sanitizer, masks etc.

Table 2 - Contents of first-aid box

Sr. No.	Description	Quantity
1	First aid leaflet	1 copy
2	Sterilized finger dressing	10 nos.
3	Sterilized hand or foot dressing	10 nos.
4	Sterilized body or large dressing	6 nos.
5	Sterilized burns dressing - small	4 nos.
6	Sterilized burns dressing - large	2 nos.
7	Sterilized burns dressing – extra large	6 nos.
8	Sterilized cotton wool (25 gms)	2 tubes
9	Cetavolon	2 tubes
10	Eye pads	6 nos.
11	Adhesive plaster	1 spool
12	Assorted roller bandage	6 nos.
13	Triangular bandages	6 nos.
14	Safety pins	6 nos.
15	Scissors, ordinary, 12.7cms, both sides sharp	1 pair
16	Antiseptic liquid, 150 ml, or equivalent	2 nos.
17	Cotton wool for padding, 100 gms	2 packets
18	Eye Ointment of sulphacetamide preparation	1 tube
19	Loose woven gauze (28”x8”), compressed pack	1 packet
20	Aspirin, 300 mg (10 tablets)	5 strips
21	Note Pad, with a pencil in a plastic cover	1 no.
22	Adhesive dressing strips	10 strips
23	Field dressing of modified army pattern	3 nos.
24	Record cards in a plastic cover	1 set
25	Torch, medium size	1 no.
26	Eye wash	1 no.
27	Wooden splints, small	1 set
28	Wooden splints, big	1 set
29	Disinfectant, Spirt, 100ml	1 bottle

l. **Proper demarcation & barricading**

Safety barricading to be done around the working area from day one to safeguard against trespassing. —people at work board must be placed to indicate work under progress in the vicinity. Barricading to be kept in place till the work is over, even if it takes few days to complete. No excavated pits / loose soil areas should be kept open without barricading around the area. Also, all storage area of materials near the working area must be demarcated and barricaded properly.

m. **Use of cranes**

- Cranes with 20% factor of safety (i.e. cranes with a lifting capacity higher than the weight to be lifted) are to be used.
- The crane should be operated by a licensed operator only.
- Operational fitness of the crane has to be checked before hiring the crane.
- The lifting hooks must have a safety lock in place to avoid slipping of the clings.
- The lifting capacity of the slings to be checked before starting of the work. The slings with 20% factor of safety in mechanical strength must be used for lifting.

n. **Working near the existing power lines:**

- No work to be taken up without proper shutdown while working in the existing power line or while working in the proximity of any existing power line.
- Work to be started only after the line (all the phases) is properly/securely earthed from both the ends and line clearance/work permit is issued by the concerned authority in writing with start and end time specifically mentioned.
- All the earthing points to be personally verified by senior engineer of contractor as EHS supervisor. Also secure against re-connection.
- No shutdown to be arranged over phone communication. Personal check is to be made for every shutdown and line clearance.
- The work under shutdown should be executed under direct supervision of a qualified supervisor/engineer of NEA and the owner (if not NEA line). The work group should not be left alone to execute the work.

o. Material handling & work process:

- Poles and accessories to be stored in proper demarcated area and should be away from the routes/places of public use.
- Ensure adequate ingress & egress around the work area.
- While lifting or shifting the equipment nobody should stay boarded.
- Correct tools and plant must be used for fixing and assembling to avoid accidents in the process. All the work must be supervised by senior engineer of contractor as EHS supervisor who can guide the team in every activity.
- While lifting heavy items with multiple sections, proper support slings (along the length) are to be provided from the point of lifting sling to the bottom of the item to avoid fall of sections due to malfunction of the slip joints.
- No persons under the influence of alcohol neither be allowed to enter the work location nor should help in the work from outside by any means.

p. **Records and documentation**

Reports prepared by the contractor shall include information on the place, date and time of the incident, name of persons involved, cause of incident, witnesses present and their statements. Based on such reports, the management can jointly identify any unsafe conditions, acts or procedures and recommend for the contractor to undertake certain mitigative actions to change any unsafe or harmful conditions.

q. Accidents and Diseases monitoring: the contractor should establish procedures and systems for reporting and recording:

- Occupational accidents and diseases
- Dangerous occurrences and incidents

These systems should enable workers to report immediately to their immediate supervisor any situation they believe presents a danger to life or health. The systems and the employer should further enable and encourage workers to report to management all:

- Occupational injuries and near misses
- Suspected cases of occupational disease
- Dangerous occurrences and incidents

All reported occupational accidents, occupational diseases, dangerous occurrences, and incidents together with near misses should be investigated with the assistance of a person knowledgeable/competent in occupational safety. The investigation should: Establish what happened; Determine the cause of what happened, identify measures necessary to prevent a recurrence, Distinction is made between fatal and non-fatal injuries. These two main categories are divided into three sub-categories according to time of death or duration of the incapacity to work.

OHS Plan will include:

1**. Safety Training Program** – to provide general and specialized training courses for all workers on the site and at all levels of supervision and management. General courses will consist of (i) an initial Safety Induction which all workers will be required to attend prior to being allowed to work on site, all visitors and project workers who have not attended the safety induction course must be always accompanied by inducted workers when within the working area. and (ii) periodic safety training refreshers covering similar topics to induction, conducted not less than once every six months. All subcontractor workers will be required to participate in relevant training courses appropriate to the nature, scale, and duration of the subcontract. Since they have heightened risk only trained workers must undertake certain activities e.g., working at height, working in confined spaces, working with electricity etc. Workers must have attended such training before they are involved in relevant works and the contractor must either offer an internal training course or organize for attendance on an external specialist training course. Workers must have a training record of attending a suitable training course. Untrained workers will not be permitted to work at height, enter confined spaces, work with live electricity etc.

2. **Medical Check-Up/Health Surveillance** – of workers fitness, eyesight, hearing, respiratory health, and communicable and noncommunicable diseases before work commences; and then repeated every six months by the contractor during construction. Only workers who have passed their fitness test and have the requisite medical clearance must undertake certain activities e.g., working with electricity etc.

3.**Safety Meetings** – will be conducted monthly during construction phase by APDCL. During construction the meetings will require attendance by the safety representatives of all contractors and subcontractors on-site. The minutes of all safety meetings including actions agreed will be taken and sent to APDCL within seven days of the meeting.

4.**Safety Inspections** – the contractor will regularly inspect, test, and maintain all safety equipment, scaffolds, guardrails, working platforms, hoists and other lifting equipment, ladders and other means of access, lighting and signage, firefighting equipment, first aid kit, stock take and condition of PPE etc. Signs will be graphic and in the languages of workers, kept clear of obstructions and legible to read. Lighting will meet illumination guidelines for the working area as per IFC EHS Guidelines on OHS. Equipment, which is damaged, dirty, incorrectly positioned or not in working order will be immediately repaired, or replaced, by the contractor.

5.**Site Audit** - during construction the contractor's H&S officer and APDCL will undertake monthly audits of compliance with the health and safety plan.

6.**Personal Protective Equipment (PPE) as a last resort where risks cannot be avoided** – workers will be provided (before they start work) with appropriate PPE at no cost to the workers. PPE provided to workers (regardless formal and informal, directly contracted or subcontracted) in accordance with GoN legislation and Table 2.7.1. Summary of Recommended Personal Protective Equipment according to Hazard in IFC EHS Guidelines on OHS including safety shoes, helmets, goggles, earmuffs, and face masks and ensure that this is always worn by them with a strict disciplinary system (no work condition if not compliant) being enforced for any non-compliance.

7.**Work Zone Noise Levels**: during construction protective measures need to be provided and as per the WB-IFC EHS Guidelines on OHS, Table 2.3.1. sets the level at 85 dB (A) for 8 hours exposure this being more stringent than the GoN requirements will be adopted, as well as 140 dB(C) peak/instantaneous noise exposure for workers working

near the high noise generating machinery. High noise work areas must be adequately signposted. In these high noise work areas PPE in the form of sound reducing earmuffs/ear plugs to the workers are to be provided. In the first instance, however, reduction in noise levels to the lowest practical level must be achieved by adoption of suitable preventive measures, such as, use of enclosures with suitable absorption material, etc. Workers operating in the high noise work areas will be given auditory tests as part of health surveillance.

8.**EMF levels** : EMF level at the construction site to be kept within international good practice levels as per ICNRP (reference and peak values) for the occupational exposure.

9.**Electricity**: IFC EHS Guideline on Electric Power Transmission and Distribution requirements for working with electricity will be observed with only licensed electricians that meet the requirements set out in them allowed to work on live electricity with strict adherence to safety standards including those listed in said guidelines. Live lines will be deactivated and properly grounded before work is performed on, or in proximity, to the lines and this will be checked and certified in writing by the contractor's Health and Safety Officer in advance. While working at heights personal safety measures such as harnesses, tool bags, ropes etc. will need to be provided.

10.**Emergency Preparedness and Response** Sub-Plan including communication systems and protocols to report an emergency e.g., health emergency, work-related accident including electrocution, traffic accident, accident involving the community, natural hazard including flooding, fire, virus outbreak etc. It will need to be developed in consultation with local emergency services with adequate fire and first aid first-responders will need to be based on the construction site to facilitate immediate response. Provide readily available first aid for workers as well as an ambulance for more serious cases. Make arrangements for a doctor on call and nearest Health Center and/or Hospital for emergency cares of workers. Regular drills will be required involving all workers to prepare for an incident.

11.**International good practice measures provided in the IFC EHS Guidelines:** https://www.ifc.org/en/insights-reports/2000/general-environmental-health-and-safety-guidelines and ILO Safety and Health in Construction (2022): https://www.ilo.org/resource/other/safety-and-health-construction-revised-edition

Labor Accommodation Requirements

Temporary Worker Accommodation

In addition to GON requirements for temporary overnight labor accommodation follow ILO Safety and Health in Construction and worker accommodation guidelines and the below points to comply with the core labor standards etc.

Day camps with temporary structures to provide protection against the weather conditions for rest and eating of food will be required at site as a rest area but these are not to be used for sleeping overnight. Adequate quantity of safe drinking water and container for their safe storage shall be provided at day camps; at least 4 liters of water per person per day to be provided for consumption during the working day at each site. If no existing toilets within 100m that can be used, temporary sanitation facilities for men and women workers shall be provided where the wastewater generated is enclosed in a container to be later taken offsite for wastewater treatment and disposal. Food provided to day camps should be cooked off site; if it is to be reheated at site fire-safety measures must be adopted with LPG cylinders or kerosene purchased from authorized vendors. After completion of the construction work the temporary structures shall be removed and the land will be restored to its earlier condition.

1.**1 General living facilities**

Location

- Appropriate siting to avoid flooding or other natural hazards
- Location within a reasonable distance from the worksite to be unaffected by the worksite's noise, emissions or dust but avoiding undue amount of time travelling to work
- Safe and free transport to the worksite where remotely located
- Built with structurally sound materials, kept in good repair, clean and free from rubbish and other refuse
- After completion of the construction work the temporary structures shall be removed and the land will be restored to its earlier condition.
- Drainage
- Adequate drainage, no waterlogging
- Heating, air conditioning, ventilation and light
- Adequate heating, air conditioning and ventilation where appropriate
- Adequate natural light and artificial light, including emergency lighting
- Water
- Easy access to an adequate supply of free, safe and potable water
- Constructed and covered storage tanks to prevent water from pollution or contamination
- Regular monitoring of drinking water quality
- Wastewater and solid waste
- Adequate discharge of wastewater, sewage, food and any other waste materials
- Disposal of sewage and other wastewater shall be made connected to an existing sewerage system or made through a septic tank-soak pit arrangement
- Separate enclosed (lidded) bins with proper markings in terms of recyclable or non-recyclable waste shall be provided in the labor camps and kitchen premises in sufficient numbers for collection of garbage.
- Specific containers for rubbish collection in adequate number and being regularly emptied
- Pest extermination, vector control and disinfection throughout the living facilities

1.**2 Rooms/dormitories facilities**

- Kept in good condition, aired and cleaned at regular intervals
- Built with easily cleanable flooring materials
- Adequate furniture (such as table, chair, mirror, bedside light) for every worker
- Lockable doors and windows with mosquito screens when necessary
- Living space and space for privacy
- Adequate living space (see also international standards for spacing at migrant workers' accommodation)
- Adequate headroom, providing full and free movement, of not less than 203 cm
- Inside dimensions of a sleeping space of at least 198 cm by 80 cm
- Minimized number of workers sharing the same room/dormitory (recommended 2–8 worker)
- Mobile partitions or curtains to ensure privacy
- Gender-segregated accommodations, except in family accommodation.
- Separate sleeping rooms for shifts to ensure no workers working during the day share a room with workers on night shifts.
- Bed arrangements and storage facilities
- A separate bed for each worker
- Minimum space of 1 m between beds
- Minimized use of double deck bunks and no use of triple deck bunks
- Enough clear space between the lower and upper bunk of the bed where double deck bunks are in use (recommended 0.7–1.1 m)
- Reasonably comfortable bedding materials (mattress, pillow, cover and clean bed linen) for each worker
- Bedding and bedframe materials designed to deter vermin
- Individual, lockable storage facilities for each worker to secure their belongings

1.3 **Sanitary facilities**

- Sanitary and toilet facilities provided for men and women including private bathing area, showers, or baths in overnight accommodation.
- Separate housekeeping staff shall be engaged for regular cleaning of the accommodation.
- Frequent cleaning and kept in good condition
- Located within the same buildings with rooms/dormitories
- Constructed from easily cleanable materials
- Shower/bathroom flooring made of anti-slip hard washable materials
- Adequate privacy, including ceiling to floor partitions and lockable doors
- Adequate number of sanitary facilities (a minimum of one toilet, one wash basin and one tub or shower for every six persons)
- Convenient and easily accessible location
- Compliance with minimum standards of health and hygiene
- Separate sanitary facilities for men and women, except in family accommodation
- Suitable light and good ventilation to open air, independently of any other part of the accommodation
- Adequately stocked soap and hygienic paper
- Adequate supply of hot and cold fresh running water (at least 80-100 liters per capita per day)

1.4 **Canteen, cooking and laundry facilities**

- If workers cook their own meals, kitchen space is provided separately from the sleeping areas.
- No labour shall be allowed to collect fuel wood/NTFP or purchase fuel wood/NTFP from unauthorized vendors.
- LPG cylinders or kerosene purchased from authorized vendors shall be provided.
- Being built with adequate and easy to clean materials
- Being kept in clean and sanitary condition
- Common dining rooms, canteens or mess rooms, and kitchen space located away from sleeping areas
- Enough space in the canteen (1–1.5 m2 per worker)
- Adequately furnished canteen (tables, benches, individual drinking cups and plates)
- Adequate facilities to maintain adequate personal hygiene (enough washbasins, clean water, materials for hygienic drying)

- Places for food preparation adequately ventilated and equipped to protect against contamination between and during food preparation
- Kitchen floor, ceiling and wall surfaces adjacent to or above food preparation and cooking areas built in non-absorbent, durable, non-toxic, easily cleanable materials
- Wall surfaces adjacent to cooking areas made of fire-resistant materials; food preparation tables equipped with a smooth, durable, non-corrosive, non-toxic, washable surface
- Adequate facilities for cleaning, disinfecting and storage of cooking utensils and equipment
- Adequate sealable containers to deposit food waste and other refuse; refuse frequently removed from the kitchen to avoid accumulation
- Implementation of the WHO “5 keys to safer food” or equivalent process in relation to food safety
- Provided food containing appropriate nutritional value and considering migrant workers' religious/cultural backgrounds
- Adequate facilities for washing and drying clothes, appropriately situated and furnished laundry facilities
- Collection of waste water from washing areas and kitchens further disposed through existing sewerage connection or septic tank with soak away

Medical facilities

- Adequate number and stock of first aid kits
- Adequate number of staff/workers trained to provide first aid
- Residents are provided guidance on alcohol, drug and HIV/AIDS and other health risks

- On site medical facilities/services (where possible and depending on the medical infrastructure existing in the community)

- Separate facilities for sick workers to prevent the spread of transmissible diseases among occupants
- Appropriate and reasonable accommodations in connection with pregnancy, childbirth and nursing

1.6 Leisure, social and telecommunication facilities

- Basic collective social/rest spaces and adequate recreational areas where not otherwise available in the community
- Dedicated places for religious observance
- Reasonable access to internet facilities, telephone or other modes of communications free of charge or at affordable/public prices

2.1 **Management and staff**

- An appointed person with adequate background, competency and experience to manage the accommodations or monitor third-party service providers
- Clear contractual management responsibilities and monitoring and reporting requirements where third-party service providers are being used
- Adequate staff to implement the accommodation standards (cleaning, cooking, security, general maintenance)
- Basic health and safety training for staff, including training in nutrition and food handling for those in charge of the kitchen
- Frequent inspection and maintenance of premises and records kept

2.**2 Fees and costs for accommodation and related services**

- Accommodation free of charge where migrant workers are not free to look for their own accommodations

- Fair and transparent renting arrangements, not costing migrant workers more than a small proportion of income (when costs are charged)
- Adequate information to migrant workers about all payments made
- Clearly specifying renting arrangements and regulations in migrant workers' employment contracts
- Food and other services provided at the facilities for free or reasonably priced (this means not above the local market price)
- No in-kind payments for accommodation and related services

2.3 Health and safety

- Adequate health and safety management plans including electrical, mechanical, structural and food safety
- Available emergency plans on health and fire safety and other specific occurrences (earthquakes, floods, tornadoes, pandemic)
- Regular training in safety and health rules and procedures for all occupants
- Posting of safety notices and operational instructions in language migrant workers understand or visual form
- Adequate number of staff/workers trained in providing first aid
- Easy access to medical facilities and medical staff, including women doctors/nurses where appropriate Guidance on alcohol, drug and HIV/AIDS and other health risks-related activities provided to migrant workers
- Access to adequate contraception measures and mosquito nets (where relevant)

Fire safety

- Specific and adequate fire safety plan and measures
- Training of fire wardens
- Installing, periodic testing and maintenance of fire equipment (alarms, extinguishers, etc.)
- Training for migrant workers in fire procedures and periodic drills (in a language they understand)
- Bedding not containing flammable materials
- Radiators and other heating apparatus properly placed to avoid risk of fire, and shielded where necessary to prevent discomfort to occupants
- Emergency evacuation plans are displayed at strategic areas in language understood by workers
- Clearly marked emergency exits
- Adequate means of escape provided and properly maintained

2.4 Security

- Security at worker's accommodation shall be ensured.
- A security plan including clear measures to protect migrant workers against theft and attack and clear provisions on the use of force
- The backgrounds of security staff checked for previous crimes or abuses
- Clear instructions for security staff not to harass, intimidate, discipline, discriminate against migrant workers or restrict the freedom of movement
- Adequate training for security staff in dealing with violence and harassment and the use of force (including gender-based violence and sexual harassment)
- Body searches only performed in exceptional circumstances by specifically trained security staff; pat down searches on women workers only performed by women security staff

2.5 Migrant workers' rights, rules and regulations on migrant workers' accommodation

- Migrant workers' 24/7 access to the accommodation; security measures reasonable and not unduly restricting migrant workers' freedom of movement
- Adequate transport system to the surrounding communities
- Withholding migrant workers' documentation papers prohibited; migrant workers entitled to keep their documents in their own lockers
- Trade union representatives' access to migrant workers in the accommodation site
- Visitor access allowed in accordance with company rules for privacy or safety
- Migrant workers' religious, cultural and social backgrounds respected
- Adequate information to migrant workers about their rights and obligations (a copy of the accommodations' internal rules, procedures and sanction mechanism in a language or through a media they understand)
- Non-discriminatory, fair and reasonable house regulations
- Effective grievance mechanisms for migrant workers to articulate their grievances
- Display of contact information of consular services, company personnel and civil society organizations at the facilities

Permanent Worker Accommodation

In addition to GON requirements for permanent labor accommodation follow ILO worker accommodation guidelines and the below additional points to comply with the core labor standards etc.

Integrity of Structures

- Surfaces, structures and installations should be easy to clean and maintain, and not allow for accumulation of hazardous compounds.
- Buildings should be structurally safe, provide appropriate protection against the climate, and have acceptable light and noise conditions.
- Fire resistant, noise-absorbing materials should, to the extent feasible, be used for cladding on ceilings and walls.
- Floors should be level, even, and non-skid.

Severe Weather

- Structures should be designed and constructed to withstand the expected elements for the region and have an area designated for safe refuge, if appropriate.

Exit

- Passages to emergency exits should be unobstructed at all times.
- Exits should be clearly marked to be visible in total darkness. The number and capacity of emergency exits should be sufficient for safe and orderly evacuation of the greatest number of people present at any time, and there should be a minimum of two exits from any work area.
- Facilities also should be designed and built taking into account the needs of disabled persons.

Fire Precautions

- Equipping facilities with fire detectors, alarm systems, and fire-fighting equipment. The equipment should be maintained in good working order and be readily accessible. It should be adequate for the dimensions and use of the premises, equipment installed, physical and chemical properties of substances present, and the maximum number of people present.
- Provision of manual firefighting equipment that is easily accessible and simple to use

- Fire and emergency alarm systems that are both audible and visible

Lavatories and Showers

- Adequate lavatory facilities (toilets and washing areas) should be provided for the number of people expected to work/live in the facility and allowances made for segregated facilities, or for indicating whether the toilet facility is “In Use” or “Vacant”. Toilet facilities should also be provided with adequate supplies of hot and cold running water, soap, and hand drying devices.

Potable Water Supply

- Adequate supplies of potable drinking water should be provided from a fountain with an upward jet or with a sanitary means of collecting the water for the purposes of drinking
- Water supplied to areas of food preparation or for the purpose of personal hygiene (washing or bathing) should meet drinking water quality standards

Lighting

- Workplaces should, to the degree feasible, receive natural light and be supplemented with sufficient artificial illumination to promote workers’ safety and health, and enable safe equipment operation. Supplemental ‘task lighting’ may be required where specific visual acuity requirements should be met.
- Emergency lighting of adequate intensity should be installed and automatically activated upon failure of the principal artificial light source to ensure safe shut-down, evacuation, etc.

Safe Access

- Passageways for pedestrians and vehicles within and outside buildings should be segregated and provide for easy, safe, and appropriate access
- Equipment and installations requiring servicing, inspection, and/or cleaning should have unobstructed, unrestricted, and ready access
- Hand, knee and foot railings should be installed on stairs, fixed ladders, platforms, permanent and interim floor openings, loading bays, ramps, etc.
- Openings should be sealed by gates or removable chains
- Covers should, if feasible, be installed to protect against falling items
- Measures to prevent unauthorized access to dangerous areas should be in place

First Aid

- Ensure that qualified first-aid can be provided at all times.
- Appropriately equipped first-aid stations should be easily accessible throughout the place of work
- Eye-wash stations and/or emergency showers should be provided close to all workstations where immediate flushing with water is the recommended first-aid response
- Where the scale of work or the type of activity being carried out requires, dedicated and appropriately equipped first-aid room(s) should be provided. First aid stations and rooms should be equipped with gloves, gowns, and masks for protection against direct contact with blood and other body fluids
- Remote sites should have written emergency procedures in place for dealing with cases of trauma or serious illness up to the point at which patient care can be transferred to an appropriate medical facility.

Air Supply

- Sufficient fresh air should be supplied for indoor and confined work spaces. Factors to be considered in ventilation design include physical activity, substances in use, and process- related emissions.
- Air distribution systems should be designed so as not to expose workers to draughts
- Mechanical ventilation systems should be maintained in good working order. Point-source exhaust systems required for maintaining a safe ambient environment should have local indicators of correct functioning.
- Re-circulation of contaminated air is not acceptable. Air inlet filters should be kept clean and free of dust and microorganisms.
- Heating, ventilation and air conditioning (HVAC) and industrial evaporative cooling systems should be equipped, maintained and operated so as to prevent growth and spreading of disease agents (e.g. Legionella pneumophilia) or breeding of vectors (e.g. mosquitoes and flies) of public health concern.

Temperature

- The temperature in work, rest room and other welfare facilities should, during service hours, be maintained at a level appropriate for the purpose of the facility.

OHS Training

- Provisions should be made to provide OHS orientation training to all new employees to ensure they are apprised of the basic site rules of work at / on the site and of personal protection and preventing injury to fellow employees.
- Training should consist of basic hazard awareness, site- specific hazards, safe work practices, and emergency procedures for fire, evacuation, and natural disaster, as appropriate. Any site-specific hazard or color coding in use should be thoroughly reviewed as part of orientation training.

Permanent Accommodation

- A separate bed for each worker
- Adequate head room, providing full and free movement, of not less than 203 cm
- The minimum inside dimensions of a sleeping space should be at least 198 cm by 80 cm
- Beds should not be arranged in tiers of more than two
- Bedding materials should be reasonably comfortable
- Bedding and bedframe materials should be designed to deter vermin
- Separate accommodation of the sexes
- Adequate natural light during the day- time and adequate artificial light
- A reading lamp for each bed
- Adequate ventilation to ensure sufficient movement of air in all conditions of weather and climate
- heating where appropriate
- Adequate supply of safe potable water
- Adequate sanitary facilities (see below)
- Adequate drainage.
- Adequate furniture for each worker to secure his or her belongings, such as a ventilated clothes locker which can be locked by the occupant to ensure privacy.
- Common dining rooms, canteens or mess rooms, located away from the sleeping areas
- Appropriately situated and furnished laundry facilities
- Reasonable access to telephone or other modes of communications, with any charges for the use of these services being reasonable in amount
- Rest and recreation rooms and health facilities, where not otherwise available in the community
- In workers' sleeping rooms the floor area should not be less than 7.5 square metres in rooms accommodating two persons; 11.5 square metres in rooms accommodating three persons; or 14.5 square metres in rooms accommodating four persons. If a room accommodates more than four persons, the floor area should be at least 3.6 square metres per person. Rooms should indicate the permitted number of occupants.

- As far as practicable, sleeping rooms should be arranged so that shifts are separated and that no workers working during the day share a room with workers on night shifts.

Sanitation Facilities

- Adequate sanitary facilities should include a minimum of one toilet, one wash basin and one tub or shower for every six persons. They should be provided at a convenient location which prevents nuisances.
- Sanitary facilities provided should meet minimum standards of health and hygiene. They should also provide reasonable standards of comfort, including hot and cold fresh running water.
- There should be separate sanitary facilities provided for men and for women.
- Sanitary facilities should have ventilation to the open air, independently of any other part of the accommodation.
- Soap and hygienic paper should be adequately stocked.
- Measures should be taken to prevent the spread of diseases. Separate facilities should be provided for sick workers to prevent the spread of transmissible diseases among the occupants.
- Fire safety measures should be taken, including installing and maintaining fire equipment (alarms, extinguishers, etc.).
- Workers should be trained in fire procedures.
- Bedding should not contain flammable materials.
- Radiators and other heating apparatus should be placed so as to avoid risk of fire, and shielded where necessary to prevent discomfort to occupants.

Inspection of premises

- Premises should be inspected frequently to ensure that the accommodation is clean, decently habitable and maintained in a good state of repair. The results of each such inspection should be recorded and be available for review.

Vacating the premises upon termination of employment

- When a worker's contract of employment is terminated, the worker should be entitled to a reasonable period of time to vacate the premises, in accordance with national law and custom.

Water Conservation

- Regularly maintain plumbing, and identify and repair leaks
- Shut off water to unused areas
- Install self-closing taps, automatic shut-off valves, spray nozzles, pressure reducing valves, and water conserving fixtures (e.g., low flow shower heads, faucets, toilets, urinals; and spring loaded or censored faucets)
- Operate dishwashers and laundries on full loads, and only when needed
- Install water-saving equipment in lavatories, such as low- flow toilets

Appendix

LIST OF ABBREVIATIONS

- FAT Factory Acceptance Test
- SAT Site Acceptance Test
- AMC Annual Maintenance Contract
- FMS Facility Management Services
- BOQ Bill of quantity
- CPU Central Processing Unit
- DC Data Center
- DR Disaster Recovery
- DRC Disaster Recovery center
- DCU Data Concentrator Unit
- DLMS Device Language message specification
- DMZ Demilitarized zone
- DT Distribution Transformer
- EMS Energy Management System
- FIFO First in First Out
- GPS Global positioning system
- IT Information Technology
- OT Operation Technology
- MV Medium voltage
- LV Low Voltage
- NEA Nepal electricity Authority
- NMM Network Management Module
- NOC Network Operation Centre
- SI System Integrator
- DWDM Data Wavelength Division Multiplexer
- OEM Original Equipment Manufacturer
- OFC Optical Fiber Cable
- OFDM Orthogonal Frequency Division Multiplexing
- OTA Over the Air

- PQM Power Quality Monitor
- RAM Random Access Memory
- ROM Read only Memory
- RF Radio Frequency
- RFP Request for Proposal
- RTC Real Time Clock
- SAN Storage area network
- SLA Service Level agreement
- SNTP Simple Network Time Protocol
- TOU Time of Usage
- MB Mega Byte
- GB Giga Byte
- TB Tera Byte
- PB Peta Byte
- VEE Validation, Estimation, and Editing
- XML Extended Markup Language