NEPAL ELECTRICITY AUTHORITY

(An Undertaking of Government of Nepal)
Project Management Directorate

DISTRIBUTION CONTROL CENTER PROJECT

A component of
Electricity Grid Modernization Project

BIDDING DOCUMENT
FOR

Design, Supply, Installation and Commissioning of Distribution Command and Control Center

(Procurement of Plant)

Single-Stage, Two-Envelope
Bidding Procedure

Issued on:	**10 August 2020**
Invitation for Bids No.:	**PMD/EGMP/DCC–077/78 - 01**
OCB No.:	**PMD/EGMP/DCC–077/78 - 01**
Employer:	**Nepal Electricity Authority**
Country:	**Nepal**

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Distribution Control Center Project
Project Management Directorate
NEA Training Centre Complex, Kharipati
Bhaktapur, Nepal

Telephone: ……

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CHAPTER 1 – PROJECT SPECIFIC REQUIREMENT (PSR)

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CHAPTER 1-Project Specification Requirement

1. General

1.1 The project is funded by the GoN and ADB to implement the infrastructure for Distribution Control Centre to bring about reform in the distribution sector. Through this, NEA aims to mirror the benefits to the customers that can be seen in a number of countries and can be replicated in Nepal Electricity Authority (NEA). In the initial stages of program rollout, the immediate benefits such as reduced interruption frequency and duration and the cut back in AT&C losses will be realized.

Nepal Electricity Authority intend to carry out the following services in Turn key mode of Contract:

Engineering, Design, supply, install, testing, commissioning, operate and maintain the Distribution Control Centre (DCC) for all distribution centre within Kathmandu valley.

1.1.1 **Area Coverage**: Contractor is required to perform the engineering and design works for network covering whole of the Kathmandu valley, as indicated in the Chapter 3, Specification. However, in this phase **Engineering, Design, supply**, installation, testing, commissioning, operation and maintenance of the Distribution automation of the area under distribution Centre in Kathmandu Valley. The underground work for Ratnapark and Maharajgunj DC are in implementation while for other DCs of Kathmandu district the contract is in initial phase. For Lalitpur and Bhaktapur district the tendering process has been started and is in initial phase. The successful bidder is required to work in close coordination with the contractor of undergrounding projects.

1.1.2 **It will be the responsibility of the Contractor to design the network scalable to cover** whole of the distribution centre within Kathmandu valley for the distribution automation system.

Existing Status of Distribution network

1. Currently the distribution network reinforcement work for Maharajgunj and Ratnapark Distribution centre is under implementation which includes installation of underground network with Distribution automation.
2. The work for distribution reinforcement of other 5 Distribution centre under Kathmandu District is in the initial phase of contract execution.
3. The tendering work for distribution reinforcement of four distribution centre under Bhaktapur and Lalitpur district is under progress and the implementation will be started soon.

4. The distribution system automation proposed for above reinforcement works include SCADA enabled RMUs, GO switches which requires to be integrated with the DCC. The distribution transformer proposed to be installed also has to be integrated with the new DCC.

   All the equipment including communication system, required for the successful operation of the automation system is in the scope.
5. The existing network is fed though network of 14 substations and 10 switching stations at 11 kV voltage level which is also required to be integrated.
6. Currently, the substation automation of 14 substation is being implemented with construction of Master Control Center (MCC) and the communication between substation and LDC & MCC is envisaged through the gateways.
7. The optical fibre network currently implemented and planned, shall be suitably reinforced such as to achieve the ring system network, to facilitate trouble free operation of the DCC.
8. Existing distribution network is overhead lines with intermittent use of ABC cables,

2.0 Scope Activities:

The following shall be in the scope of the Contractor:

1. Refer Chapter 3 for scope of work.

Note:

a) Any minor electrical/ communication equipment/items which are not mentioned in the biding 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..

b) 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.

c) The employer will decide the service provider the for GSM/GPRS connectivity if required and will manage the availability of the sim cards for connectivity from DCU to DC. The responsibility of complete network development shall be with the contractor.

d) The bidder shall include all the cables, connectors, network cables etc required for the completion of scope of work in the respective item in the BPS.

2.1 Additional information:

2.1.1 The employer intends to construct Distribution Control Center (DCC) at NEA owned substation complex at Suichatar, Kathmandu.

2.1.2 The DCC building is intended to be prefabricated modular (container type) structured 3 storeyed building, to house the DCC, office area, SOC, NOC and infrastructure for Data Center (DC). The design shall be such that it can be scaled to 4 storied building.

2.1.3 The DCC building is required to be constructed within 9 months from contract effective date.

2.1.4 The DCC is intended to control and supervise the distribution network to realize the distribution automation of Kathmandu valley.

2.1.5 The contractor is required to propose and install the system which is suitable and scalable to accommodate all required control and supervisory monitoring system of all area under the distribution centre (13 DC) under Kathmandu valley.

2.1.6 Currently, areas under 2 DCs are in advance state of implementation while other 11 DCs are under initial state of implementation and thus, needs to be integrated with the DCC. The distribution system automation proposed for reinforcement works include SCADA enabled RMUs, GO switches which requires to be integrated with the DCC SCADA DMS. The distribution transformer proposed to be installed also has to be integrated with the new DCC. The Contractor shall propose the system compatible to integrate with above system and shall provide the all required equipment and provision for integration with the field equipment.

2.1.7 The distribution network is fed by 14 substations at 11kV voltage level. The contractor is required to integrate the control and supervisory monitoring function of these feeders with the DCC though relays, Contact multiplier Relays (CMR), Multi-Function Meters (MFM). Also, currently, substation automation works for these 14 substations are under way and the communication system is envisaged though the gateways.

2.1.8 The distribution network is also supplied by 10 switching stations at 11kV voltage level. The contractor is required to integrate the control and supervisory monitoring function of these feeders with the DCC though relays, Contact multiplier Relays (CMR), Multi-Function Meters (MFM). Communication equipment.

2.1.9 The NEA intends to establish the main DCC with facility of control and monitoring through the Distribution centre level also. Therefore, the proposal shall include such facility such as to implement trouble free system.

2.1.10 **The contractor is required to quote for the item in Schedule 1, Part C, DC area and other area** considering and including the minimum requirement stipulated in the technical specification, Annexure 4, 9.4.3.1 but not limited to them.

2.1.11 All the equipment including communication system, required for the successful operation of the automation system is in the scope. The cost for such supply and installation shall be included in the respective cost in the BPS.

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.

2.1.12 ***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 DCC building is intended to be Pre-fabricated Modular (container type) structured 3 storied building, to house the DCC, office area, SOC, NOC and infrastructure for Data Center (DC). The intended area for building is 300Sq.m plinth area.

b) Construction of store building. The contractor shall design Store Building for the floor area 150 sqm (single store) with RCC column to support the Color CGI (26 gauge Medium) Roof Truss including all electrical systems etc. Detail design of Roof Truss and RCC column is based on the relevant IS codes, The Contractor shall submit the detail design and drawings to the Employer for approval. With the approved design and drawings, the contractor shall construct the store building, and the payment is made by Employer as per BOQ.

c) The contractor shall restore the existing army barrack building to use it as the store building complete with racks.

d) Construction of underground water tank. The contractor shall design 1 number of underground tank for the DCC building use and 2 numbers for LDC & Substation. The contractor is required to dismantle existing underground water treatment system tanks and reconstruct at different locations, where required. The contractor shall study the existing system and restore it with regards to capacity and function.

The Contractor shall submit the detail design and drawings to the Employer for approval. The cost for the dismantling works shall be included with the bid price.

e) All civil works including foundations associated with DCC building, store, Diesel generator.

f) Cable trenches, ductway etc inside and outside DCC buildings.

g) Foundations of generators, along with jacking pad and pylon supports, etc

h) Soil investigation: The contractor is required to perform the soil investigation. The cost for such report shall be included in the rate quoted for the building.

The bidders are advised to visit the substation 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 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.

2.3 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 final destination for successful erection, testing and commissioning of the substation/switchyard.

2.4 Final Checking, Testing and commissioning

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. Physical and other Parameters

3.1 **Location of the Project Site**

Project site is within the Kathmandu Valley.

3.2 **Meteorological data:**

a) Altitude above sea level: 1420 m

b) Ambient Air Temperature:

-5 ºC (minimum) to 40 ºC (maximum)

c) Average Humidity (in %) :

100 (maximum), 40 (minimum)

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

e) Seismic Requirement for Substations: 0.5 g (Horizontal peak acceleration value).

However, for design purposes, ambient temperature should be considered as 50 degree centigrade and Relative humidity 100%. Altitude (from MSL) to be considered as 1400 meter.

4. 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 AMI shall be included in the bid price and shall be provided at no extra cost to Employer.

5. Basic Reference Drawings

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

5.2 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.	Chapter 1 : Project Specific Requirement	
2.	Chapter 2 : General Requirement	
3.	Chapter 3: Specification	

6. 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.

7. 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**.**

8. 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.

9. Specific Requirement

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

b. 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 Inspector's clearance 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.

c. 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.

d. Augmentation and integration work related to SCADA System

e. The Contractor shall impart the necessary training to Employer’s Personnel as mentioned in BPS:-

10. Social Safeguard and Environment and Management Plan

The Contractor shall prepare 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 others 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 noise 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. Safety of Personnel

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.

15. Consultant for the Project

NEA is in process of appointing the Post contract supervision consultant for this Project. The consultant shall be responsible for all work related to the execution of the project including billing of the project.

CHAPTER 2- GENERAL TECHNICAL REQUIREMENT

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1.0 FOREWORD

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

2.0 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.

2.3 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 inter-changeable with one another.

3.0 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 compliment 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.

4.0 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 equipments 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.

5.0 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 alongwith 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 which might affect substation layout. 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.

5.5 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.

5.7 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 per substation 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) Type test reports (one scanned softcopy in pdf format per substation plus one for corporate centre & one hardcopy per substation)	2 weeks from the date of final approval
	(b) Routine Test Reports (two copy for each substation)	-do-
vi)	Furnishing of instruction/ operation manuals (4 copies per substation and one softcopy (pdf format) for corporate centre & per substation)	As per agreed schedule
(vii)	As built drawings (Four sets of hardcopy per substation & one softcopy (pdf format) for corporate centre& per substation)	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 substation, 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.

6.0 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 Incase 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 fulfill 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.

6.1.4 All materials and equipment shall be installed in strict accordance with the manufacturer’s recommendation(s).

6.2.1 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 out door: 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 under which the item of substation in question has been designed to operate, and such diagram plates as may be required by the Employer. The rating plate of each equipment shall be according to IEC requirement.

7.0 LEFT BLANK

8.0 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 Purcahser.

(l) System for maintenance of records;

(m) System for handling storage and delivery; and

(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.

9.0 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 alongwith 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 atleast 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 notice 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 comply 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 equipments for these tests shall be provided by the Employer.

10.0 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.

10.3 The Contractor shall be responsible for obtaining statutory clearances from the concerned authorities for commissioning the equipment and the switchyard. However necessary fee shall be reimbursed on production of requisite documents.

11.0 PACKAGING & PROTECTION

11.1 All the equipments 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 pipings and conduit equipment connections shall be properly sealed with suitable devices to protect them from damage.

13.0 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.

13.3 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 equipments 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 equipments 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.

13.6 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.

13.7 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.

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

14.0 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.

15.0 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	190V to 240V	DC	-	Isolated 2 wire System
110V	95V to 120V	DC	-	Isolated 2 wire System
48V	_	DC	_	2 wire system (+) earthed

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

Contents

SECTION-VI (CIVIL WORKS REQUIREMENT)

As required and applicable for the project

1. GENERAL

Nepal Electricity Authority (NEA) is constructing an Distribution Control Center (DCC) building at the premises of Suichatar Substation. The DCC building shall house Infrastructure for DC, DCC, SOC, 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

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

- Exploration works for soil strength for foundations of DCC Building.
- Site Installation
- Site clearing and stripping for related works.
- 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.
- Supply, Construction and Installation of water supply and sanitary system
- Supply and installation of Illumination systems.
- All associated and necessary civil and architectural works to complete the specified scope of work

NOTE: This specification shall be read in conjunction with the requirement mentioned in the specification, section 3, Annexure 4. 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.

vi 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.

2. 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, strucutures, 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 tones at the site of work.

2.10 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 equipments.		

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. 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.

3.7 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 Leveling

The bottom of all foundation should be trimmed and leveled 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 color 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 not 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 effect 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 not 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 gradation requirements:

A2.12. Table - I

GRADTION FOR FINE AGGREGATE

Percentage by Weight Passing					
Sieve Size 10 mm	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 course 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 form 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 in to 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 produced 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 center 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 center of vibration approximates to center 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 fill the spaces between the coarse aggregate so as to form a glistening and even surface except for slight irregularities where the coarse aggregates breaks 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, colorless liquid sealing compound in atomized form so as to preserve the natural color 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 manufacture'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, screeded 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 surfaces shall be made good.

The top faces of slabs not intended to be surfaced shall be leveled 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 leveling. 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 exceed 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 measured in cu. m. of the concrete work done as per design, drawing. Unless specified otherwise nothing extra shall be admissible for any particular shape of the footing.

A3. REINFORCEMENT

A3.1. 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.

A3.2. 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.

A3.3. 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.

A3.4. 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.

A3.5. 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.

A3.6. 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 there to 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.

A3.7. 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

A4.1. Centering and shuttering including propping, strutting etc and removal of forms including applying Form Oil to Shuttering

A4.2. 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 centering 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.

A4.3. Deflection and Camber

The Contractor shall make allowance for any settlements of deflection of the formwork that is likely to arises 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.

A4.4. 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.

A4.5. 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 fiberboard 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."

A4.6. 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.

A4.7. 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.

A4.8. Striking or Removal of Formwork

All formwork 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 ^{0}C	7^{0}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 that 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.

A4.9. 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 water proof plywood with taped joints or any other approved material. The Consultant/Employer shall approve the finish.

Measurement

No extra payment will be made.

BRICKWORK

A4.10. Kiln made first class brick in foundation and plinths in cement mortar 1: 6 (1 cement: 6 sand) for brickwork.

A4.11. 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 kiln 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 color. 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 $\pm$ 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 coarse 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.

A4.12. 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 as in E9.2.

A4.13. Machine made first class brick as above

Workmanship

All the work shall be done as per specification in item E9.2. The maximum lift involve above plinth level shall be 15 m. Scaffolding of required nature shall be provided as necessary.

A4.14. 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 scantling 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.

The timber shall conform to item E11.1

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 rue 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 o 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 centers 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.

i. Clear glass 3mm thick
ii. Clear glass 4mm thick
iii. Clear glass 5.5mm thick
iv. Wired glass 6mm thick
v. Frosted glass 3mm thick
vi. Frosted glass 4mm thick
vii. Frosted glass 6mm thick
viii. Patterned glass 3mm thick
ix. Patterned glass 4mm thick
x. Patterned 6mm thick
xi. Red transparent glass 4/6 mm thick
xii. Green transparent glass 4/6 mm thick
xiii. Blue transparent glass 4/6 mm thick
xiv. Tinted glass of brown color 6mm thick
xv. Tinted glass of dark color 6mm thick

a. Materials

The glasses used shall be Modi brand or 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 water tight. 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 suto 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 / aluminum, 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 aluminum

xvi. Mortise lock keyed, anodized aluminum

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 aluminum, 230mm

xxiii. Tower bolt, anodized aluminum 150mm

xxiv. Tower bolt, anodized aluminum, 100mm

xxv. Door stoppers, brass

xxvi. Door stoppers, anodized aluminum

xxvii. Door stoppers, chrome plated

xxviii. Eye hook, brass 250 mm

xxix. Eye hook, anodized aluminum, 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 where 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 fixture 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 centers, 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 b 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 leveled 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 Sq.m. 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 mm. 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 water logged 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 color 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 color & 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 color 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 b 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 Sq.m.

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 color and paints to give uniform coloring after rendering the surface clean and moist.

Inside and outside coloring 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 Sq.m.

a. Materials

i. Gypboard

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 centers. 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 center 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 centers.

c. Fixing

After framing work is completed, fixing of 12.5mm tapered edge Gypboard (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 center. 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 Gypboard 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 Sq.m.

a. Materials

i. Gypboard

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 Gypboard (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 center. 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 Gypboard or E-board (as per recommended practices of India Gypsum or E-board or Equivalent).

B. SPECIFICATIONS - ELECTRICAL INSTALLATION WORKS (As applicable)

(Refer the specification section 6.3 also)

B1. Scope:

The works covered shall include supply of all materials, labor, 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, labor, 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 one year. 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 labor 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 40^0C.

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 aciditation and phosphatation process before two coats of red oxide primer are applied, then two final coats of enamel paint of approved color 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 incommer MCCB. The bus bars shall be sufficiently supported by insulator so that insulation resistance shall not be less than 20 mega ohm.

B7.3. Arrangement shall be made at the bottom of the control panel for receiving incoming cable .Space for out going 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 aciditation and phosphatation process before two coats of red oxide primer are applied, then two final coats of enamel paint of approved color 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 incommer MCCB. The bus bars shall be sufficiently supported by insulator so that insulation resistance shall not be less than 20 mega ohm.

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.

B8.7. The gap between two TP MCCBs as well as that of TP MCBs shall not be less than 40 mm and 30 mm respectively.

B8.8. All the outgoing MCB shall be marked by the tag covered by transparent PVC pocket permanently fixed on the inner cover.

B8.9. 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 leveled 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 then 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 colors 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 color 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:

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
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

Fire Alarm Panel	Siemens/CTEK

Notes:

1. The bidder must get approval by the Employer/ consultant, for the samples before installation.
2. Samples of the items whose standard make are not indicated shall be submitted and get approved by the Employer/ consultant before installation.
3. The Bidder shall furnish proper certification in original or authentication letter from the concerned manufacturer or it's distributors confirming the genuinity of the materials being offered. Failing to submit such certification or letter would automatically rejects the material.

B13.1. CEMENT

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

a. The weight of cement in sealed bags shall be considered as 50 Kgs. Being equivalent to 35 litres (1.2 Cft.) in volume.

b. Cement shall be stored in weather proof 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 to 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 exceed 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 off 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 san 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 14 inches (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 (1200 mm) 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 n 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 branches 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. Incase 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

(IS : 1729 – 1964 for a sand cast soil pipes)

Nominal 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 leaded 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 lead 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 water tight 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 where 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 through out 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, Thallow shall then be removed from the prepares 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.

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

The joints shall be water – tight and shall be free from tears, burrs, strings, ribandsor 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 m.	Approx. Outside dia.	Screwed and socketed wt. Per meter			Screwed and Socketed meter per kg.		
		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 hessain 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 pipe line 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**
Upto 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 foot rests 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 vireouseIst 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 water tight.

iii. The distance between center 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 waster 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 in range	Capacity	Size of main flush pipe	Size of branch pipe mm	Size of dism. 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 viterios 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 bubles, 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 Aluminum 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 waster 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 centering 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 provided a special type 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. Hoppern 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 anu 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.

Chapter 6.3

Technical Specification

TECHNICAL SPECIFICATION

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1. INTRODUCTION AND GENERAL INFORMATION

1.1 Introduction

Nepal Electricity Authority (NEA) is a Power Generation, Transmission and Distribution Corporation that provides electricity services for Nepal. It was created on August 16th, 1985 under the Nepal Electricity Authority Act. 1984 through merger of the Department of Electricity, Ministry of Water Resources, Nepal Electricity Corporation, and related Development Boards.

The primary objective of NEA is to generate, transmit and distribute the adequate, reliable, and affordable power by planning, constructing, operating, and maintaining all generation, transmission, and distribution facilities in Nepal's power system both interconnected and isolated. In addition to achieving the above primary objective, NEA's major responsibilities are:

a) To recommend the Government of Nepal on long and short-term plans and policies in the power sector.
b) To recommend, determine and realize tariff structure for electricity consumption with prior approval of Government of Nepal.
c) To arrange for capacity building to produce skilled manpower in generation, transmission, distribution, and other sectors.

NEA owns hydroelectric power plants connected to the grid amounting to 480 Megawatts. It also buys power from Independent Power Producers (IPP) amounting to 230 Megawatts. It operates two fuel operated power plants collectively generating 53 megawatts of electricity. During FY 2016, the total electricity sales of NEA was 3,746 GWh and total available electric energy was 5,100 GWh.

To improve its distribution network management, the NEA intends to award work to a suitable System Integrator who shall carry out Complete, installation , configuration , commissioning , operation and maintenance of Data Center(DC) including Network Operating Centre (NOC) and Security Operating Centre (SOC) and a Master Distribution Control and Command Centre Center(DCC) along with all requisite SCADA/DMS-OMS hardware (including field equipment) and software etc. across Kathmandu valley within a radius of 220 sq. miles.

SCADA – DMS-OMS Software shall be based on the Service-oriented Architecture (SOA) and shall enable very simple integration with other standard software and hardware equipment applied in the environment of electricity distribution (GIS, MDM/AMI, equipment automation, etc.).

1.2 Existing Status

NEA has started the procedure for adoption of the modern digital technology including AMI Solution/Smart meters into its existing electrical system, which shall assist in the enhancement of its operational efficiency, reduce energy theft and enable itself to serve its customers in a better way.

It is also taking steps for automation of its day to day business operations by implementation of advance software solutions, some of the key solutions that are under planning/implementation process include Utility Billing Solution, Enterprise Resource Planning (ERP) System, Geographical Mapping System (GIS Mapping), Preparation of Distribution System Master Plan, Smart Meter/Grid Tied Meter (Net Meter), Substation Automation System etc.

NEA is envisaging and planning for a phase wise implementation of the Advanced Metering Infrastructure (AMI) System in Kathmandu valley and subsequently at its provincial Discom areas. Some of the key solutions operating at NEA includes the following:

1.2.1 Geographical Information System

NEA has planned to prepare a GIS based inventory to track its poles, transformers, cables, consumers' connections up to each transformer to know all the data and their existences in the distribution system. Purpose of this system is to help the managers to know the actual information about poles, transformers, and consumers' capacity and to balance the transformer's load as per connection load to the consumers.

At present the pilot survey test of the project has already started on Jorpati DCS with 19,000 No's of (Nineteen thousand) consumers. For upcoming fiscal year, the survey of additional 16 DCS has been planned. Moreover, this GIS system shall also support in the identification of No-Light section to locate the network fault in a reliable way.

GIS based Data Survey work will be conducted in Financial Year 2018-19 for 31 branches namely Bhadrapur, Anarmani, Damak, Rangeli, Biratnagar, Duhabi, Ithari, Inaruwa, Rajbiraj, Lahan, Siraha, Mirchaiya, Sakhuwa, Janakpur, Jaleshwar, Gaur, Kalaiya, Birgunj, Simara, Banaeshwar, Pulchok, Thimi, Bhairahwa, Taulihawa, Nepalgunj, Ghorahi, Tulsipur Surkhet, Tikapur, Dhangadhi, Mahendranagar.

As of now, the pilot survey test and procurement of hardware has already initiated for the GIS project at Jorpati and Ratnapark DCS.

1.2.2 Metering Billing and Collection System

NEA has implemented decentralised billing system in 175 DCS covered under 8 Regional Offices.

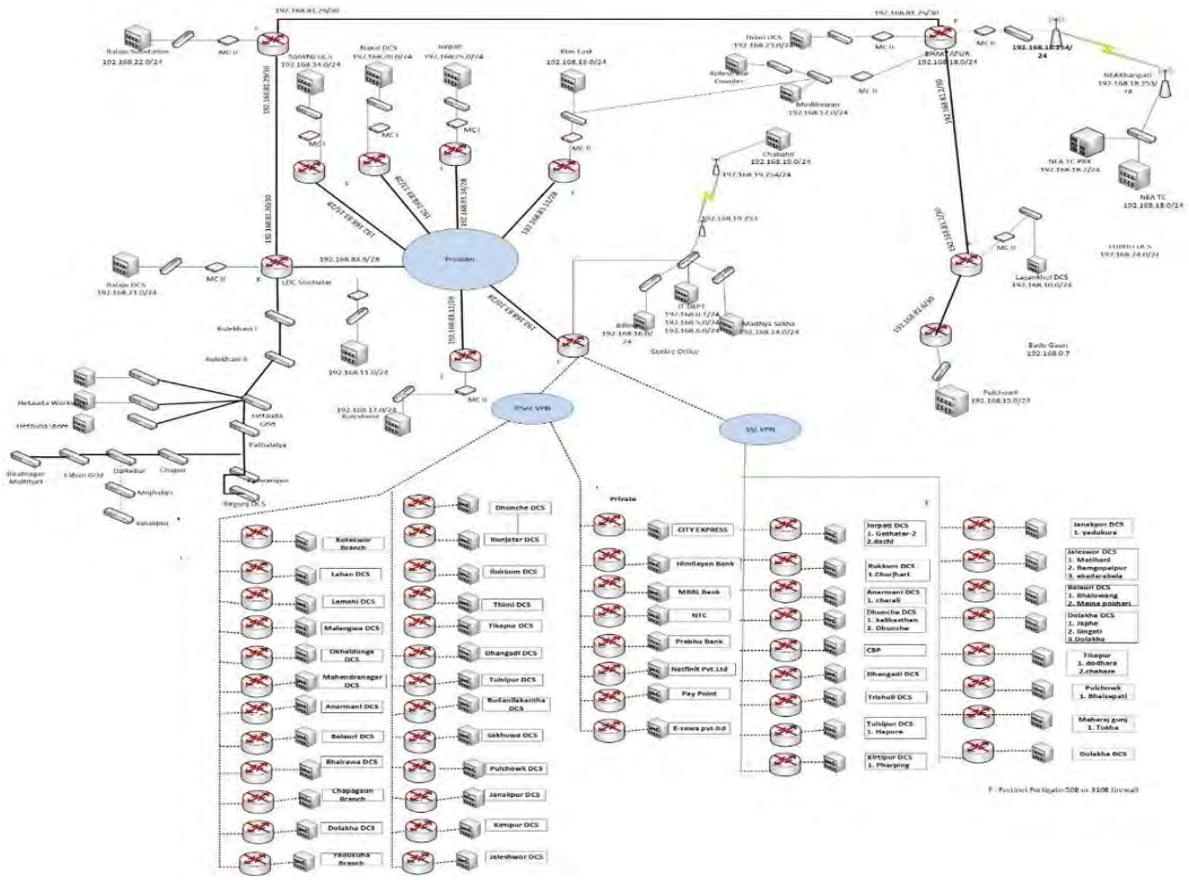


Figure 1: Network Connectivity Architecture of NEA

1.2.3 Remote Meter Reading System

Nepal Electricity Authority (NEA) is under process to implement an integrated, automated, secure and reliable system for Remote automatic meter reading (RMR), data management & data processing and analysis of TOD meters installed at NEA.

As of now, 10,000 modems (appx.) are installed on legacy meters for Meter Data Acquisition, the MDAS and MDM system are being provided by M/s Analogics. NEA is also procuring 60,000 No's (appx.) of 3-phase whole current smart meters which are having TOD, Net metering and pre-payment capabilities and shall be used for billing of HT consumers.

The RMR System shall be an integrated system with centralized web based software and IT equipment's for Data collection, Data transfer and Load research of meter data from various remotely installed Time of Day (TOD) meters. The proposed system shall handle a majority of the wide range of revenue meters manufactured by different vendors which are being used by Nepal Electricity Authority (NEA) including meter makes like Actaris, EDMI, Waison, Bluestar etc.

NEA project will be based on 100% GPRS based modern telecommunication facilities available in Nepal. This solution will also have a provision to use Hand Held Devices like Common meter reading instrument (CMRI) for manual data download from meters in case the above-mentioned system fails to collect data automatically.

The RMR system will have an intelligent device which will be connected to an Electronic Energy Meter by means of optical/RS232 port, installed at various consumer premises (HT/LT consumers) to collect the following data as per configured frequency/On demand.

1. Complete RAW data stored in the Meter. (daily/weekly/monthly)
   a. Instantaneous parameters at the time of reading
   b. Billing data, Present Data & Last 12 months histories, if meter has the histories stored in it
   c. Load survey, 30 days/complete no. of days stored
   d. Tamper data
   e. Settings/Configuration data etc.
2. Instantaneous parameters (every 15/60 minutes/daily)

The acquired data will be pushed to the Data Centre (DC) over GPRS network. Meter Data Acquisition (MDA) software shall be deployed at DC that shall support data acquisition from thousands of AMRs simultaneously. The AMR device shall have in-built intelligence and high-speed data transfer rate or a kind of store–forward facility by which data from the meter is read at regular intervals and stored in AMR device internal memory and forwarded to Data Center (as configured). Acquired RAW data after processing shall be converted into XML CDF file for integration with Data Analysis & Reporting, Billing, EA System etc.

The intelligent AMR devices will be capable of a two-way communication, which should automatically connect to GPRS network without requiring AT commands. The internal hardware watchdog protected input power circuit should be available. It should connect to any RS232 or optical port cable.

The Central RMR Web server will be equipped with required leased line connectivity with internet using private IP address, Firewall Device, 4G/3G/GPRS modems and networked with local AMRs, for remote data collection, archiving, database management and updating the summary reports to the Central AMR Server.

1.2.4 Other IT Applications

Information Technology Department is responsible for the core IT-related services within the organization with its rudimentary Data Centre located in the IT department building at central office. Apart from the implementation of New IT systems, the Department also provides continuous ICT support, maintenance and trainings at local and regional levels. A significant effort is also being made by the department towards the intranet expansion with fibre optical cable and wireless connectivity.

Remote network services are also being provided through ADSL, Leased Line and VPN for NEA offices to use different applications. The department facilitates central procurement section for procuring the computer hardware, networking components by preparing tender documents, technical specifications and cost estimations. It has also carried out the centralization, implementation, and enhancement of the following systems:

- Centralization of the Payroll and Pension Management Information System which was functioning in a decentralized mode at more than 200 NEA offices.
- Centralization of the Accounting System which was running in a decentralized mode at more than 492 NEA offices.
- Fixed Asset Management System and Inventory Management System are operating in a decentralised manner.
- The department has introduced New NEA website and added some portal services in it.
- In current fiscal year, the E-attendance system has been implemented at more than 60 new NEA offices.
- The Online meter application and Complain management systems were developed and implemented in 5 regional offices and in their respective branches.
- The management of NEA has decided to process the E-bidding through government portal www.bolpatra.gov.np which is facilitated by the PPMO (Public Procurement Monitoring Office site) from Shrawan 2075 onwards.
- A total of 134 buyers and 865 bidders have been registered at new e-bidding portal and 1427 contracts were facilitated.
- IT department is also planning to upgrade the rudimentary Data Centre into a full-fledged facility including implementation of Disaster Recovery Centre (DR) for Business Continuity.

Many other key initiatives are taken by other different Directorates of NEA including IT and OT automation which are at various stages of implementation and roll out. Some of the key initiatives are as listed below:

- Substation Automation solution implementation is completed at Baneshwor 66kV Substation and Dhalkebar 220kV Substation by M/s ABB.
- Distribution Transformer Monitoring System pilot is being executed at Ratnapark DCS by M/s Analogics.
- EV Charging Station is installed and running at Ratnapark DCS.
- ERP RFP document is under formulation and going to be published.
- Power System Simulation for Engineering is implemented and functioning at systems planning division of NEA.
- Valoragua and Wein Automatic System Planning Package (WASP) – System planning division is currently using this freeware solution and planning to initiate the upgrade of needful.
- Existing SCADA EMS solution upgradation is under process by M/s Siemens.
- Roll out and Implementation of Any Branch Payment System etc.

1.3 Brief Scope of Work

The project scope of work is to design, supply, erect, install, testing, commissioning, operate and maintain hardware, software, civil infrastructure, IT and Non- IT infrastructure housed in the Data Centre (including NOC, SOC, DCC) and SCADA-DMS- OMS across the Kathmandu Valley .

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

- Design layout of civil and Non- IT Infrastructure of DC, NOC, SOC and DCC and the system architecture of SCADA – DMS OMS capable of upgrades and scaling as per future requirements and depicting integration with existing and upcoming systems including system security and access with due consideration of data privacy, confidentiality cyber security guidelines etc.
- Communication network engineering and designing
- Baseline Parameters/KPIs proposed for improvement and monitoring.
- Procurement of necessary technology, equipment, and services for the project.
- Supply, installation, and commissioning of RTUs, CMRs, MFTS, Video Projection System (VPS) etc.
- Supply installation and commissioning of servers, software for SCADA DMS, OMS, ISR, LDMS /Supporting Systems etc. with required licenses and compute with scalability of 100%.
- Supply installation and commissioning of necessary hardware and software systems at Data Center (DC), Network Operating Centre (NOC), Security Operating Centre(SOC) and Distribution Command and Control Centre(DCC). The Data Centre shall house all the IT and Non- IT systems (servers and software) procured for SCADA DMS project. It shall also house the requisite systems (servers and software) for other projects such as ERP, Distribution Automation, Advanced Metering Infrastructure (AMI), GIS, and Revenue Management System etc. The necessary hardware and software required for the functioning of the Data Centre(DC), NOC, SOC, DCC viz racks, civil and non- IT infrastructure, PC, Printers, switches routers, Video Projection Systems(VPS), workstations etc.
- 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.
- End to end integration with existing legacy systems, AMR,AMI Solution stack (Phase 1st : for KTM Valley 2 DCS is already under implementation and other AMI implementation that might take place during the duration of this project (Planned is for another 8 DCS of KTM Valley and 2 DCS each for other 6 provinces) and upcoming utility systems including Metering, Billing & Collection Systems (Both existing Distributed MBC System and Upcoming Centralized MBC System), ERP Solution, GIS System, DTMS, APFC, substation automation system(SAS), Transmission, Generation SCADA, Load Dispatch Center(LDC), other Smart initiatives by NEA etc. The integration is expected to be Industry Standards Based on IEC 61968-1 Bus (SOA Enabled on enterprise Bus) using CIM/XML, OPC, ICCP etc. which is, on-line, real time or offline where appropriate and shall operate in an automated fashion without manual intervention ,which is which is documented for future maintenance. SI shall make necessary provisions/software linkages in the proposed solution so that the IT system or any legacy SCADA/DMS system may be integrated seamlessly. Integration is also envisaged with the LDC and Master Control Centre of NEA. With respect to the integration with SAS, the bidder shall be able to fetch the data through the gateways procured under SAS project of NEA. The bidder is also required to provide end to end integration with the RTUs procured as part of this project.
- The SI will be responsible for integration and successful operation of the FRTU, GO and other communication equipment installed in another contracts of distribution reinforcement and automation, with the DCC and SCADA DMS, such as to complete the scope of work with full functionality. The contractor shall include any communication equipment, switches. FODP, Connection boxes and other accessories as required in their bid price such as to complete the scope of work without any extra cost to employer.
- The SI shall do the necessary study of existing system, equipment and submit the detail network diagram and report to NEA.
- Construction of the NEA Data Centre Building that shall house the Data Center (DC), Network Operating Centre (NOC), Security Operating Centre (SOC) and Distribution Command and Control Centre (DCC) and other centers as desired by NEA.

Recommendation on business process realignment with advent of SCADA DMS implementation for organization e.g. Prerequisites to expand the SCADA DMS solution to rest of Nepal and business process alignment for seamless information flow to/from systems.

- Development of Interface with web portal/dashboard, mobile application, customer care center etc.
- Specialized and basic training to the employees of the NEA pertaining to their areas of work. This activity shall include change management and capacity building sessions including training of users for effective use of the SCADA DMS system along with field equipment related training.
- Support for Roll out, Go-Live and Stabilization for SCADA DMS system at all locations.
- Cover all systems, equipment, hardware, software etc. under complete warranty under the implementation period.
- Provide Annual Technical Support (ATS) for a period of 3 years after the date of Go-live declaration and acceptance of the project for SCADA DMS Software.
- Provide Annual Maintenance Contract (AMC) including spares etc. for a period of 3 years after the date of Go-live declaration and acceptance of the project for SCADA DMS system hardware at DC and at field.
- Provide Operation and Maintenance (O&M) Services to the NEA including Facility Management Services with helpdesk and IT support services to the NEA for a period of 3 years after the date of Go-live and acceptance of the project for SCADA DMS system.
- O&M including supply of Manpower for DC, DCC, NOC and SOC Civil Build and Non IT Infrastructure Setup for 4 years from Go Live.
- Annual Maintenance Contract services for DC, DCC, NOC and SOC Civil Build and Non IT Infrastructure Setup for 4 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 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 shall provide experienced, skilled, knowledgeable and competent personnel for all phases of the project, to provide the utility with a high-quality system.
    - **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 of all necessary information among all concerned agencies.
    - **Scope Change Management:** Utility to finalize the scope change management procedure during development/Implementation stage
- 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 system, Air conditioning and ventilation, firefighting system and Access control system required for DC, DCC, NOC and SOC are in the scope of SI, however contractor has to indicate the space requirement for DC, DCC, NOC, SOC ,RTU /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.

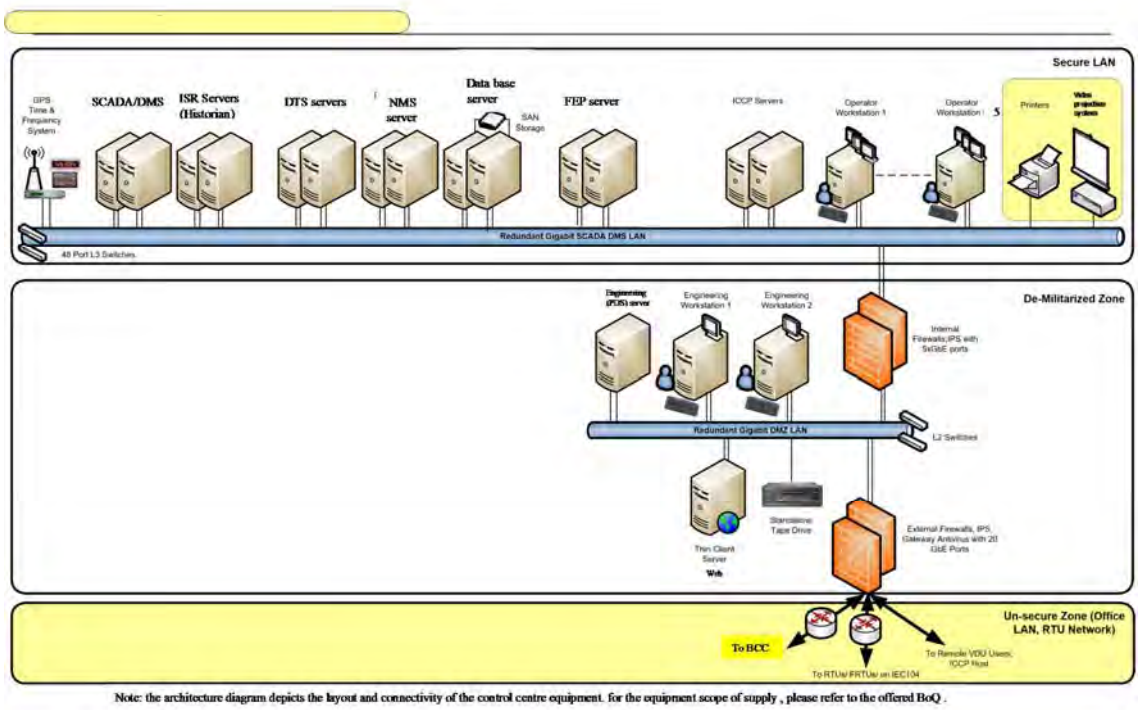


Figure 2: Indicative Utility Architecture with Integrated Application and Services

1.3.1 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 (at their own expense), prior to the submission of the proposal, and make surveys and assessments as deemed necessary for proposal submission.

1.3.2 Requirement Gathering & Solution Design

- SI should carry out a detailed requirement gathering exercise with stakeholders and management of NEA for roll out of SCADA DMS System.
- Overall sizing and designing of SCADA DMS system should be based on the As-Is status study and requirement gathering exercise.
- SI should prepare and submit a detailed solution and deployment architecture of the SCADA DMS system. (HLD & LLD Reports)
- The finalized proposed solution architecture should be submitted and approved by the NEA before solution customization, development and roll out.

- SI should also assess the end user capacity level at each location and suitably modify capacity building/change management programs in consultation with the NEA.
- Establishment of AMI communication network canopy.

1.3.3 Provisioning of DC, NOC, SOC and DCC

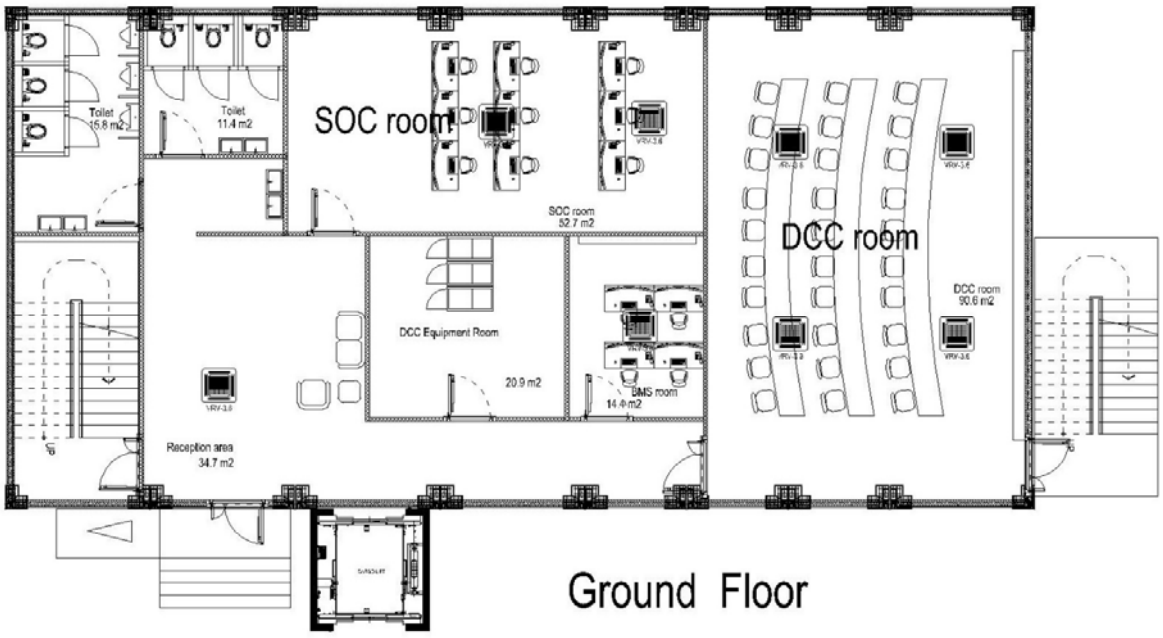
- SI shall be responsible for supply and installation of necessary hardware, software and supporting systems for successfully running the SCADA DMS system operations for the scope of work at Data Center of NEA.
- Shall supply and install the additional licenses for SCADA DMS with data storage and two-way communication between NEA and field equipment.
- SI shall update the existing licenses and version SCADA DMS to the latest commercially available version during the currency of the contact.

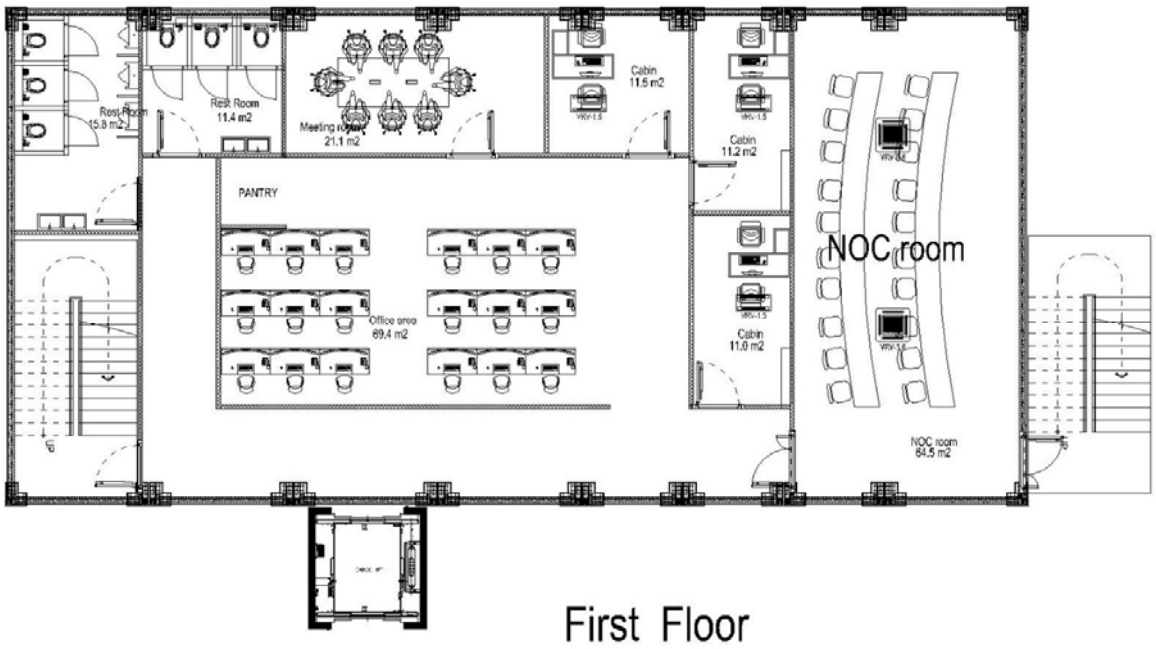
1.3.4 Provisioning of Field Equipment (RTU, MFM, CMR etc.)

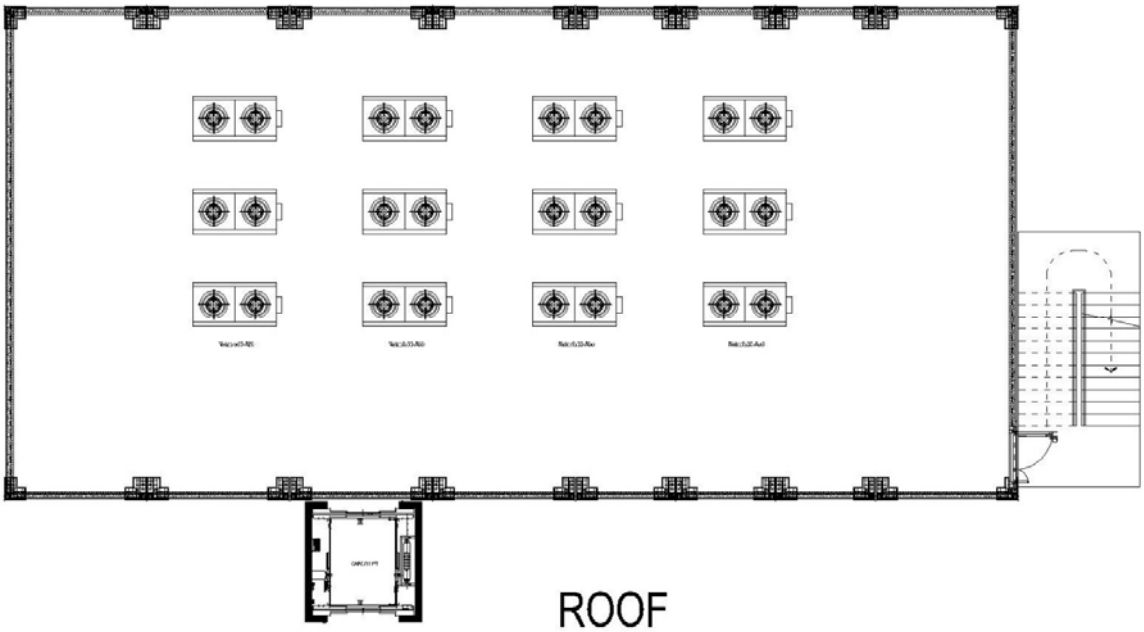
- SI shall be responsible for supply, installation, and commissioning of RTUs, CMRs, MFTS, etc. For field installations at Substations.
- The responsibility of the SI shall include supplying, laying and termination of the cables, wherever required for:
    - Acquiring analog data using MFM, transducer, sensor which shall relate to the primary devices.
    - Acquiring the digital data for status of field devices, relays in the control room.
    - Extending control output to field devices through heavy duty relays
    - Interconnection between Contact Multiplying Relays (CMRs) and RTUs & field devices (CMRs to be supplied by the contractor as per BOQ),
    - Power and signal cabling between the supplied equipment & Owner's equipment's.
    - Any other cabling required for completion of the project

1.3.5 Provisioning of SCADA building and Facility (DCC/SOC/NOC/office area, furniture etc.)

- SI shall be responsible for construction, interior decorating for DCC/SOC/NOC/office area.
- The responsibility of the SI shall include constructing, installing and commissioning of the furniture, equipment, wherever required for:
    - Interior decorating DCC/SOC/NOC area.
    - Installation for furniture in DCC/SOC/NOC area, and SI shall ensure that the materials used for furniture and equipment meet human health requirements.
    - Install facility for office area, including wash room/other working room
    - Any other facility required for completion of the project in DCC/SOC/NOC/office area.
- Si shall design the area layout plan in accordance with the following floor plan: The floor plan may change during Detail engineering.


Toilet
15.8 m2
Toilet
11.4 m2
SOC room
SOC room
52.7 m2
DCC room
DCC room
90.6 m2
DCC Equipment Room
20.9 m2
BMS room
14.4 m2
Reception area
34.7 m2
Ground Floor


Rest Room
15.8 m2
Rest Room
11.4 m2
Meeting room
21.1 m2
Cabin
11.5 m2
Cabin
11.2 m2
PANTRY
NOC room
Office area
69.4 m2
Cabin
11.0 m2
NOC room
64.5 m2
First Floor



NOTE: The Layout shown is tentative. The layout shall be finalized during detail engineering.

1.3.6 Establishment of Last Mile Communication

- The supplied smart field devices shall have a provision for GPRS/GSM communication technology, as per the specifications. Bidder will ensure communication/connectivity with centralized Data Center by establishing the connectivity over suitable/available communication network like optical fibre / RF / GSM, after approval from the employer.
- The required data from the field devices shall reach the DCU/Access Points etc. (which are to be installed at NEA's fiber optic nodes) through the networking elements such as Routers, Repeaters,

and Extender Bridges etc as required. All equipment and accessories required shall be included in the bid price in the respective items.

- Bidder shall use the GSM/GPRS connectivity to connect the DCU/Access Points to the data center where optical fiber connectivity is unavailable.
  All above requirement shall be realized using minimum numbers of fiber pairs (which will be provided by employer), using active networks if required for data acquisition and control.

1.3.7 SCADA DMS Solution Integration

- Bidder should submit an End-to-End Integrated SCADA DMS solution and architecture clearly depicting integration between AMI and other Distribution, Transmission and Generation applications.
- The SI needs to carry out the integration of SCADA DMS system with existing decentralized MBC system and with the upcoming Centralized MBC system of NEA. (if required)
- NEA is in process of designing, installing, and commissioning a separate MDM system along with the AMR/RMR capability for approx. 10,000 Industrial metering points, the SI shall carry out the integration of SCADA DMS system along with the proposed AMR/RMR system to generate any outputs as sought by the utility.
- NEA is also using SCADA for transmission and generation which needs to be integrated with the SCADA DMS system using ICCP.
- There are also other decentralized applications for system planning viz. PSSE, Valoragua/WASP which the SI needs to carry out a study and finalize input parameters.
- Besides the above applications NEA will be implementing ERP and Revenue Management System, Substation Automation System, Distribution Automation System, GIS etc during the currency of the project which needs to be integrated with the SCADA DMS system, as required.
- The DCC should be seamlessly connected with the National Load Dispatch center and other dispatch centers constructed by NEA during the currency of the project at no extra cost to NEA.
- The proposed architecture should guarantee the capability of handling more than **40 Substations** with High Availability, High Security with High Performance in full load for the components like concentrators/access points. The software performance shall be tested through virtual metering point simulation tools which will be provided by the bidder
- NEA will also implement other components & technologies pertaining to the smart grid solution in coming future.
- The SI shall ensure that the proposed system should be such that any future integration as stated above shall not be dependent on the OEM of the proposed system, technically or commercially. For example – The system under the current scope should be able to integrate with a smart metering system that is currently installed and might be extended in future, without any extra cost paid to the SI/OEM or without any specific integration requirement given to the smart metering vendor.
- Therefore, the proposed system and overall solution shall be capable to support the vision of modern/ smart grid. It shall be capable to integrate with modern distribution center and support latest grid automation technologies as well.

1.3.8 Testing

- SI shall carry out the testing, commissioning and acceptance of overall SCADA DMS system including hardware and software of DC, DCC, NOC and SOC 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 5 years from the date of commissioning or the SI shall have to replace the equipment with an equipment (hardware and software) of same specifications.

General

This section describes the specific requirements for testing and documentation of the SCADA/DMS system. The general requirements of testing and documentation are covered in as below**.**

Type Testing

Equipment's wherever mentioned in the specification for type testing shall conform to the type tests listed in the relevant chapters. Type test reports of tests conducted in third party accredited Labs or internationally accredited labs with in last 5 years from the date of bid opening may be submitted. In case, the submitted reports are not as per specification, the type tests shall be conducted without any cost implication to employer.

Factory Acceptance Tests (FAT)

The SCADA/DMS system including DC center (DC is part of the project area) shall be tested at the Contractor's facility. All hardware and software associated with the SCADA/DMS system and at least two RTUs along with, LDMS &10 RTUs & all Remote VDUs, shall be staged for the factory testing and all remaining RTUs /FPIs shall be simulated for the complete point counts (ultimate size). The requirements for exchanging data with other computer systems like DR (if DR is not a part of the project area), IT system under various schemes, SLDC shall also be simulated.

Each of the factory tests described below (i.e. the hardware integration test, the functional performance test, integrated system test and unstructured tests) shall be carried out under factory test for the SCADA/DMS system. The factory tests, requiring site environment, shall be carried out during the Field Tests after agreement for the same from owner.

Hardware Integration Test

The hardware integration test shall be performed to ensure that the offered computer hardware, conforms to this Specification requirements and the Contractor supplied hardware documentation. All the SCADA/DMS system hardware shall be integrated and staged for testing. Applicable hardware diagnostics shall be used to verify the hardware configuration of each equipment. The complete hardware & software bill of quantity including software licenses & deliverables on electronic media shall also be verified.

System Build test

After completion of hardware integration test, the SCADA/DMS system shall be built from the backup software on electronic media (CDs/Magnetic Tapes) to check the completeness of backup media for restoration of system in case of its crashing/failure. The software deliverables shall include one copy of backup software on electronic media.

Functional Performance Test

The functional performance test shall verify all features of the SCADA/DMS hardware and software. As a minimum, the following tests shall be included in the functional performance test:

a) Testing of the proper functioning of all SCADA/DMS & other software application software's in line with the requirements of various sections of technical specification.
b) Simulation of field inputs (through RTU/FPI) from test panels that allow sample inputs to be varied over the entire input range
c) Simulation of field input error and failure conditions
d) Simulation of all type of sample control outputs

e) Verification of RTU /FPI communication Protocol IEC60870-5-104 /101 etc
f) Verification of MFT communication Protocol MODBUS etc
g) Verification of compliance of supporting interfaces such as IEC61850, IEC60870-5-103 etc.
h) Verification of CIM compliance
i) Verification of Security & Encryption using SSL for all RTU/FPI connectivity
j) Verification of Data Integration from SCADA/DMS system other systems viz IT Systems etc over Open Standards over CIM/XML, IEC 61968 Series Standards, OPC, ICCP etc.,
k) Verification of Integration between GIS / SCADA/DMS System over OAG, CIM/XML or tight Native Integration, that enables updates within GIS to percolate over ESB / SOA to IT Systems
l) Verification of data exchange with other systems
m) Verification of interoperability profile of all profiles of all protocols being used.
n) Verification of RTU /FPI communication interfaces
o) Verification of LAN and WAN interfaces with other computer systems
p) Testing of all user interface functions, including random tests to verify correct database linkages
q) Simulation of hardware failures and input power failures to verify the reaction of the system to processor and device failure
r) Demonstration of all features of the database, display, and report generation and all other software maintenance features on both the primary and backup servers. Online database editing shall also be tested on primary server.
s) Demonstration of the software utilities, libraries, and development tools.
t) Verification that the SCADA/DMS computer system meets or exceeds employer's performance requirements (as per table for peak & normal loading in section 8Verification of Design parameters as mentioned in section 8 & wherever defined in the specification.
u) Verification that ultimate expansion requirements are met.
v) Verification of DTS (if it is in the project area)
w) Verification of Development system
x) Verification of data transfer of main to back up SCADA/DMS system.
y) Functions of DR system, if it is in the project area.
z) Unstructured testing of the SCADA/DMS system by employer. The unstructured tests shall include the test, which are not in the approved test procedures and may be required to verify the compliance to the specification. (Max 20% of total testing)

Continuous operation Test (48 hours)

This test shall verify the stability of the SCADA/DMS hardware and software after the functional performance test has been successfully completed. During the test, all SCADA/DMS functions shall run concurrently and all Contractor supplied equipment shall operate for a continuous 48 (forty-eight) hour period with simulated exchange with other interconnected system viz. various IT system etc. The test procedure shall include periodic repetitions of the normal and peak loading scenarios defined**.** These activities to be tested may include, but shall not be limited to, database, display, and report modifications, configuration changes (including user-commanded processor and device failover), switching off a primary server and the execution of any function described in this Specification. During the tests, uncommanded functional restarts or server/device failovers are not allowed; in case the problems are observed, the Contractor shall rectify the problem and repeat the test.

Field Tests (Site Acceptance tests -SAT)

The SCADA/DMS system shall be tested at the site. All hardware and software associated with the SCADA/DMS system along with all RTUs/ /FPIs etc. along with all field devices including MFTs connected shall be tested under the field tests.

Field Installation Tests

The equipment which has undergone the factory testing shall be installed at site and integrated with the RTUs / FPI and other computer systems though the communication medium.

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
f) Random checking of SCADA/DMS software basic functions

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

End-to-End Test

After the field installation tests, the Contractor shall carry out end-to-end test to verify:

a) the communication of RTUs /FPIs/MFTs with SCADA/DMS system
b) the RTU / FPI communication channel monitoring in the SCADA/DMS system
c) the mapping of SCADA database with RTU / FPI database for all RTU/FPI points
d) the mapping of SCADA database with displays and reports

The Contractor shall provide the details of all the variances observed and corrections carried out during end to end test.

Field Performance Test

The field performance test shall concentrate on areas of SCADA/DMS operations that were simulated or only partially tested in the factory (e.g., system timing and loading while communicating with a full complement of RTUs/ FPI and data links and system reaction to actual field measurements and field conditions). Further the validity of factory test results determined by calculation or extrapolation shall be examined.

After the end to end test, the Contractor shall conduct the field performance test to verify the functional performance of the system in line with the technical specification which includes the following:

a) the communication of other system i.e IT, SLDC, DR system with SCADA/DMS system
b) Mapping of SCADA/ISR database with other system database viz IT, SLDC, DR system.
c) Verify that all the variances observed during the Factory test are fixed and implemented.
d) Conduction of the Factory tests deferred (tests requiring site environment)
e) Functional tests of SCADA/DMS system
f) Verify the execution rates of all SCADA/DMS application
g) Verify update rate & time for data update & control command execution as per specification requirements
h) Verify the response time of all SCADA/DMS applications.
i) Verify the response time for User interface requirements
j) Testing of all features of the database, display, and report generation and all other software maintenance features on both the primary and backup servers. Online database editing shall also be tested on primary server. (k) Conduction of unstructured tests as decided by the Employer

System Availability Test (360 hours)

Contractor shall provide & approve theoretical and practical figures used for this calculation at the time of detailed engineering. The calculation shall entail reliability of each individual unit of the System in terms of Mean Time Between Failures (MTBF and a Mean time to Repair (MTTR) as stated by OEM. Reliability figures of existing equipment shall be supported by evidence from operational experience at similar types of installation / figure given by OEM.

From those data, the unavailability of each sub-system shall be calculated taking in account each item redundancy. The global availability shall then be calculated from those different unavailability data. This calculation shall lead to the failure probability and equivalent global MTBF data for the control center system.

The overall assessment of System availability shall be provided in the form of an overall System block diagram with each main item shown, complete with its reliability data. The calculation of overall availability shall be provided with this diagram.

System availability tests shall be conducted after completion of the field tests. The system availability test shall apply to the SCADA/DMS system (hardware and software) integrated with its RTUs/ FPIs and IT SYSTEM. However, the non-availability of RTUs/Data Concentrators/ FPI, IT system etc & Communication System shall not be considered for calculating system availability. However, RTU, communication equipment's, Auxiliary power supply shall be tested as per the provisions given in their chapters.

The SCADA/DMS system (hardware and software systems) shall be available for 99.5% of the time during the 360hours (15 days) test period. However, there shall not be any outage /down time during last 85 Hours of the test duration. In case the system availability falls short of 99.5%, the contractor shall be allowed to repeat the system availability test after fixing the problem, failing which the system shall be upgraded by the contractor to meet the availability criteria without any additional cost implication to the owner.

Availability tests of RTUs shall be conducted along with System availability test for 360 hours. Each RTU shall exhibit minimum availability of 98%. In case the RTU availability falls short of 98%, the contractor shall be allowed to repeat the RTU availability test (for failed RTU only) after fixing the problem, failing which the equipment shall be upgraded by the contractor to meet the availability criteria without any additional cost implication to the owner.

In the event of unsuccessful reruns of the availability test, employer may invoke the default provisions described in the General Conditions of Contract. The system availability tests will be performed by the owner by using the SCADA/DMS system and RTUs/ FPI for operation, control and monitoring of distribution system and using Contractor supplied documentation. The owner will also be required to generate daily, weekly and monthly reports. The supplied system shall be operated round the clock.

The SCADA/DMS system shall be considered as available if

a) one of the redundant hardware is available so that all the SCADA/DMS applications are functional to ensure the design & performance requirement as envisaged in the specification
b) at least one of the operator console is available
c) at least one of the printers is available (off-lining of printers for change of ribbon, cartridge, loading of paper, paper jam shall not be considered as downtime)
d) All SCADA applications are available
e) All DMS applications are available
f) All SCADA/DMS functions described in the specification are executed at periodicities specified in the specification. without degradation in the response times
g) Requests from available Operator Consoles & VPS are processed
h) Information Storage and Retrieval applications are available
i) Data exchange with other system is available

However, each device, including servers, shall individually exhibit a minimum availability of 98%. The non-availability of following Non-Critical functions shall not be considered for calculations of system availability; however, these functions should be available for 98% of the time.

a) Database modification and generation
b) Display modification and generation
c) Report modification and creation
d) DTS

During the availability test period, employer reserves the right to modify the databases, displays, reports, and application software. Such modifications will be described to the Contractor at least 48 hours in advance of implementation to allow their impact on the availability test to be assessed, except where such changes are necessary to maintain control of the power system.

The successful completion of system availability test at site shall be considered as **"operational acceptance"** of the system.

Down Time

Downtime occurs whenever the criteria for successful operation are not satisfied. During the test period, owner shall inform the Contractor for any failure observed. For attending the problem, the contractor shall be given a reasonable travel time of 8 hours. This service response time shall be treated as hold time and the test duration shall be extended by such hold time. The downtime shall be measured from the instant, the contractor starts the investigation into the system and shall continue till the problem is fixed. In the event of multiple failures, the total elapsed time for repair of all problems (regardless of the number of maintenance personnel available) shall be counted as downtime. Contractor shall be allowed to use mandatory spares (on replenishment basis) during commissioning & availability test period. However, it is the contractor's responsibility to maintain any additional spares as may be required to maintain the required system availability individual device/ equipment availability. All outage time will first be counted but if it is proven to be caused by hardware or software not of Contractor's scope, it will then be deducted.

Hold time

During the availability test, certain contingencies may occur that are beyond the control of either employer or the Contractor. These contingencies may prevent successful operation of the system, but are not necessarily valid for measuring SCADA/DMS availability. Such periods of unsuccessful operation may be declared "holdtime" by agreement of employer and the Contractor. Specific instances of holdtime contingencies could be Scheduled shutdown of an equipment, Power failure to the equipment, Communication link failure.

RTU TESTING

(a) Type Testing

A complete integrated unit shall be type tested to assure full compliance with the functional and technical requirements of the Specification. The testing sample shall include at least one of each type of cards/modules and devices. The list of Type tests to be performed on the RTU is mentioned in **Table-1** & type test requirements are mentioned in **Table-2**

The contractor may optionally submit type test reports for all the EMI/EMC tests conducted at accredited laboratory for review & approval by Owner. However, in the event, the type test reports are not meeting the specification requirement, Owner may ask for the type testing of any or all the above tests as required at no additional cost to the owner.

The type test of RTU w.r.t. functional tests shall be carried out in all cases. Contractor shall commence commercial production of RTUs after successful completion of all type tests and approval from Owner.

Further, type test reports for meters, transducers and relays shall be submitted as per relevant standards. All weather sensors shall be calibrated as per Nepal Metrological Department standards and certificate shall be submitted in this regard.

(b) Routine Testing

Each complete unit shall undergo routine testing. The list of Routine tests to be performed in the factory is mentioned in **Table-1**.

(c) Field Tests

After RTU panel installation and interface cabling with C&R panels and communication equipment, the Contractor shall carry out the field-testing. The list of field tests is mentioned in **Table-1**.

(d) Availability Tests

After field testing, RTU shall exhibit 98% availability during test period of 500 hours. Availability tests shall be performed along with Master station. The RTU shall be considered available only when all its functionality and hardware is operational. The non-available period due to external factors such as failure of DC power supply, communication link etc., shall be treated as hold-time & availability test duration shall be extended by such hold time.

Table-1: List of Tests on RTU

Test Nos.	DESCRIPTION OF THE TEST	Type test	Routine test	Field test
	FUNCTIONAL TESTS FOR RTU			
1.	Check for BOQ, Technical details, Construction & Wiring as per RTU/ drawings	√	√	√
2.	Check for RTU database & configuration settings	√	√	√
3.	Check the operation of all Analog inputs, Status input & Control output points of RTU	√	√	√
4.	Check operation of all communication ports of RTU/	√	√	√
5.	Check for communication with master stations or master station simulator for RTU/	√	√	√
6.	Test for downloading of RTU database from Master station	√		
7.	Test for RTU time synchronization from Master	√		√
8.	Test Power Supply Voltage Margin, Ripple Levels and Short Circuit Protection	√		
9.	Test for RTU operation with DC power supply voltage variation	√		
10.	Check for auto restoration of RTU on DC power recovery after its failure	√	√	√
11.	Test for RTU diagnostic feature	√		
12.	Test for RTU SOE feature	√		
13.	RTU Analog accuracy test for analog input	√		
14.	Transducer accuracy test	√	√	
15.	Test for IEC 60870-5 -104, 61850 & Modbus protocol implemented	√		
16.	Test for RTU internal Clock stability	√		

Test Nos.	DESCRIPTION OF THE TEST	Type test	Routine test	Field test
17.	Test for RTU Noise level measurement	√		
18.	Test for Control Security and Safety for Control outputs	√		
19.	Other functional tests as per technical specification requirements	√		
20.	End to end test (between RTU/ & Master station) for all I/O points			√
	EMI/EMC IMMUNITY TESTS FOR RTU			
21.	Surge Immunity Test as per IEC 60870-2-1	√		
22.	Electrical Fast Transient Burst Test as per IEC-60870-2-1	√		
23.	Damped Oscillatory Wave Test as per IEC 60870-2-1	√		
24.	Electrostatic Discharge test as per IEC 60870-2-1	√		
25.	Radiated Electromagnetic Field Test as per IEC 60870-2-1	√		
26.	Damped Oscillatory Magnetic Field Test as per IEC-60870-2-1	√		
27.	Power Frequency Magnetic Field Test as per IEC-60870-2-1	√		
	INSULATION TEST FOR RTU			
28.	Power frequency voltage withstand Test as per IEC 60870-2-1	√		
29.	1.2/50 µs Impulse voltage withstand Test as per IEC 60870-2-1	√		
30.	Insulation resistance test	√		
	ENVIRONMENTAL TEST FOR RTU			
31.	Dry heat test as per IEC60068-2-2 / 2-3	√		
32.	Damp heat test as per IEC60068-2-78	√		
33.	Cold Test as per IEC60068-2-1	√		

Note: Test levels for above type tests are elaborated in Table 2

Table-2: RTU Type Test Requirements

Test Nos.	Test Name	EUT Status	Test Level	Power Supply Points		I/O Points	Passing Criteria
				CM	DM	CM	
1	Surge Immunity Test	ON	Level 3	2 kV	1 kV	2 kV	A
2	Electrical Fast Transient Burst Test	ON	Level 3	2 KV	-	1 kV	A
3	Damped Oscillatory Wave Test	ON	Level 3	2.5 kV	1 kV	2.5 kV	A
4	Electrostatic Discharge Test	ON	Level 3	+/- 6 kV in Contact discharge mode or +/- 8 kV in Air discharge mode			A
5	Radiated Electromagnetic Field Test	ON	Level 3	10 V/m electric field strength			A
6	Damped Oscillatory Magnetic Field Test	ON	Level 3	30 A/m at 1MHz of magnetic field strength			A
7	Power frequency magnetic field	ON	Level 3	30 A/m of magnetic field strength (Continuous duration sine wave)			A
8	Power frequency voltage withstand	OFF	-	1 KVrms for 1 minute			No break down or flashover shall occur
9	1.2/50µs impulse voltage withstand	OFF	-	2 kVp			No break down or flashover shall occur
11	Insulation Resistance Test	OFF	-	Measure Insulation resistance using 500 V DC Megger before & after Power Freq & Impulse voltage withstand tests			As per manufacturer standard
12	Dry heat test	ON	-	Continuous operation at 55^0 C for 16 hrs.			0
13	Damp heat test	ON	-	at 95% RH and 40^0 C for 16 hrs.			0
14	Cold test	ON	-	Continuous operation at 0^0 C for 96 hrs.			0

Note: -

1. EUT - Equipment Under Test
2. CM - Common Mode; DM - Differential mode
3. I/O pints do not include Communication ports

4. Passing Criteria
   0 - no failure: normal performance within the specified limits

   A: minor failure: temporary degradation or loss of function or performance which is self-recoverable

5. Functional test as per the sl. nos. 1-18 of Table-2 shall also be done during type testing.

DC Testing

FAT & ISAT: Once the implementation is done, testing of individual components will take place. Items those require factory test may be done at the OEMs premises at the cost of the bidder. Once the items are tested individually, an integrated test should be done at the site with full simulated condition. Bidder should provide load banks and tools as required for the test at his own cost.

Final Acceptance Testing

- The final acceptance shall cover 100% of the Date Center
- 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.

1.3.9 Training for SCADA, DMS, RTU's

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 finalized during project execution.

General

(a) Training will be conducted by Contractors 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) For all training courses, the travel and per-diem expenses will be borne by the owner.
(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.

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.

Database, Display Building & Report generation Course

The database and display building course shall be the first course to be given in the overall training sequence. It shall be a hands-on course using the hardware and software to be supplied by the contractor. The course shall be designed to train owner personnel in how to develop the databases, displays, reports, and logs for the offered system.

Course objectives shall include:

(a) How to set up a database & display development system
(b) How to identify database fields, entries, records, tables, and contents
(c) How to structure RTU table definitions
(d) How to build tables, arrays, and report formats and displays.
(e) How to perform database maintenance
(f) How to generate the database from source Information
(g) How to maintain symbol libraries, display color groups, and display string lists.

On course completion, all participants shall be able to prepare the necessary input data to define the system operating environment, build the system database and displays, and prepare the database administrator to maintain and modify the database and its structures.

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, 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. Administration of Database (both Realtime and RDBMS),
(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.

RTU Course

The Contractor shall provide an RTU course that covers the following subjects as a minimum:

(a) Theory of operation of all RTU functions
(b) Operational procedures for various modes of operation, including diagnostic tests and interpretation of the associated test results
(c) Implementing and maintaining multiple communication ports
(d) Converting an RTU from one protocol to a different protocol
(e) Demonstration of complete RTU test set use, including test set connection and set up for all possible modes of operation, all operational procedures, the exercise of each command or feature associated with each mode of operation, the interpretation of results, and how to use the test set to diagnose and isolate RTU problems
(f) Disconnection and replacement of all RTU equipment, including all modules within the RTU

Operator Training Course

This training course shall provide training to Owner's operators on SCADA/DMS and Billing & Customer Care Systems so that operators can manage the system effectively.

The training shall include:
(a) System Overview: Configuration of the system, a functional overview, and an overview of system capabilities and performance.
(b) General Operating Procedures: Hierarchical structure of displays, display capabilities and features, user procedures, log-on and user access restrictions, and error messages.
(c) System Applications: Theory of operation, capabilities, and operating procedures for each application function.
(d) Handling of Equipment: Minor maintenance operations, such as removal of stuck paper in printers etc., which do not require spares/specialized skills.
(e) Operator Documentation: Orientation in the organization and application of all user documentation for Operator and verification of the information contained therein.

The course shall focus on hands-on training on the system. The trainees shall perform instructor-defined procedures with the help of the dispatcher documentation. In addition, there shall be training for Instructor to use DTS.

Communication System Training:

The training shall focus on critical aspects associated with installation, testing & commissioning of fiber optic system, radio. 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 fiber 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.

1.3.10 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 15-20 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, electrical systems, BMS systems like access control, fire detection and suppression system, security aspects of the Data Center, education on how the passive network cabling has been done on the overall expansion area build etc

1.3.11 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 enterprise wide Go-live of SCADA DMS system (including, DC, DCC, NOC and SOC.
(b) The details of activities covered under the facility management and expected service levels are mentioned in 'Operation and Maintenance Services'.

1.3.12 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:

- Upcoming Solution Integration with existing SCADA DMS system.
- Additional IT Infrastructure Capacity Augmentation.
- Achieving Required Performance and SLA Requirements
- RTU Read related issues
- 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 with in the SLA's

1.3.13 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.
- SI shall ensure the effective transition of the project to a successor agency or NEA, and to ensure business continuity. All the As-Is project data required for transition and successful operations of SCADA DMS system shall be readily available in the format specified by NEA.
- The exist management process will include but not be limited to, conducting a detailed walkthrough and demonstrations of the SCADA DMS system, 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.

1.3.14 Change Management

- Bidders will detail their change management methodology and activities for implementation of SCADA DMS system.
- 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.
- Change management will include the customization of software (Including development) for integration with other existing and/or forthcoming subsequent phases of SCADA DMS system.
- 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.

1.3.15 Facilities to be provided by NEA

- 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 arranging 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.

1.4 Documentation and Deliverables

1.4.1 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.

1.4.2 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.

1.4.3 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 SCADA/DMS 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 software and hardware deliverable
M. Protocol implementation documents
N. Point address document
O. IP addressing plan document
P. Software User document for dispatchers
Q. Software Maintenance document
R. Training documents
S. Real time & RDBMS documents
T. Database settings, Displays and Reports to be implemented in the system
U. Test procedures
V. Test reports
W. Hardware description documents
X. Hardware User documents

Y. Hardware Maintenance documents
Z. Data Requirement Sheet (DRS) of all Hardware
AA. Site specific Layout, Installation, GA, BOQ, schematics and cabling details drawings/documents
BB. SCADA & IT Integration Plan Document using CIM/XML Adapters & Messaging Interfaces.
CC. Cyber Security Plan & Mitigation document for the system if Public Networks are used.
DD. Interoperability profiles/ Tables
EE. Go-Live Criteria Compliance
FF. FMS Reports
GG. Change Management
HH. Exit Management Report
II. User Manuals
JJ. System Administrator Manuals
KK. OEM Functional Manuals
LL. Product Manuals
MM. Technical Manuals
NN. Installation Guides
OO. Business Process Guides
PP. Program Flow Descriptions
QQ. Sample Reports
RR. Screen Formats
SS. Toolkit Guides
TT. Troubleshooting Guides
UU. FAQ Guides
VV. Any other Document/Report/Certification as required by NEA.

B. Documents and Deliverables – DC , DCC , NOC, SOC Civil and Non IT Infrastructure

A. Basic Layout taking the Data Center
B. Access Control System Layout
C. Cold Aisle Containment
D. Electrical layout
E. Lighting 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. The contractor shall also submit two sets of the standard documentation of Operating system and Databases in electronic media. Paper copies of these may be submitted, if the same are available from the OEM as a standard part of delivery. One copy of the software packages used for accessing & editing the final documentation in electronic media shall also be provided. After successful completion of System availability test, the contractor shall take the software backup of complete SCADA/DMS system on electronic media and two copies of these backup software shall be submitted to the owner.

1.5 System Go-Live and Acceptance Criteria

1.5.1 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.
- DC, DCC,NOC and SOC Civil Build and Non IT Infrastructure Tested, Supply, installation and commissioning completed as per scope.
- Hardware and software for SCADA DMS Tested, supplied, installed and commissioned at DC, DCC as per scope.
- RTU test, supplied, installed and commissioned as per scope.
- Network connectivity provisioned and communicating at all locations as per scope
- Completion of Software customizations
- Completion of Software testing as per Bid Documents
- User Acceptance Testing Completed
- 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
- Software Change and Release Management Process in Place as per NEA acceptance
- Exit Management and Handover Plan Accepted by the NEA
- Detailed Schedule Available for Go - Live
- Roll Back Plan Available
- Adequate Man Power for O&M in Place for Handover
- Scope of Work Completed and Signed off by NEA.

1.6 Implementation Plan and Schedule

The SCADA DMS system is planned to be implemented in three different phases as described in Figure 3 according to the timetable shown in

Sl. No	Activity Name	M 0	M 1	M 2	M 3	M 4	M 5	M 6	M 7	M 8	M 9	M 10	M 11	M 12	M 13	M 14	M 14	M 15	M 15	M16 TO Mxx	M17 To Mxx
1	**Contract Finalization and Award of Work**																				
2	**Project Initiation Phase:**																				
a	Project Kick Off																				
b	Presentation on Execution Approach & Methodology to Senior Management																				
c	Onsite Office Setup & Team Mobilization																				
d	Project Inception Report																				
e	Site Survey Report for DC, NOC, DCC, SOC Civil and Non IT Infrastructure.																				
f	Site Survey report of Substation including network feasibility.																				
3	**Design Blueprinting Phase of DC, DCC, NOC and SOC:**																				
a	As-Is Study																				
b	Requirement gathering workshops																				

Sl. No	Activity Name	M 0	M 1	M 2	M 3	M 4	M 5	M 6	M 7	M 8	M 9	M 10	M 11	M 12	M 13	M 14	M 14	M 15	M 15	M16 TO Mxx	M17 To Mxx
c	Gap Analysis																				
d	To-Be Process Design																				
e	Updation of Requirement Specifications																				
f	Technical Design Documents – Layouts, schematics for DC, DCC, NOC, SOC.																				
4	**Design Blueprinting Phase of SCADA System:**																				
a	As-Is Study																				
b	Requirement gathering workshops																				
c	Gap Analysis																				
d	To-Be Process Design																				
e	Updation of Requirement Specifications																				
f	Technical Design Documents – HLD & LLD with layouts, schematics for DC, DCC, SS including communication network architecture																				

Sl. No	Activity Name	M 0	M 1	M 2	M 3	M 4	M 5	M 6	M 7	M 8	M 9	M 10	M 11	M 12	M 13	M 14	M 14	M 15	M 15	M16 TO Mxx	M17 To Mxx
5	**DC, NOC, SOC, DCC Civil and Non IT Infrastructure I&C:**																				
a	Procurement equipment/material for civil build and Non IT Infrastructure																				
b	Supply equipment/material for civil build and Non IT Infrastructure																				
c	Install equipment/material for civil build and Non IT Infrastructure																				
d	Commission DC, NOC, SOC, DCC and Non IT Infrastructure and ready for occupancy																				
6	**SCADA DMS System IT and Field Infrastructure I&C:**																				
a	Procurement of SCADA DMS system equipment's (including																				

Sl. No	Activity Name	M 0	M 1	M 2	M 3	M 4	M 5	M 6	M 7	M 8	M 9	M 10	M 11	M 12	M 13	M 14	M 14	M 15	M 15	M16 TO Mxx	M17 To Mxx
	hardware and software to be deployed at DC, DCC)																				
b	Supply of SCADA DMS system equipment's (including hardware and software to be deployed at DC, DCC)																				
c	Installation of SCADA DMS system equipment's (including hardware and software to be deployed at DC, DCC)																				
d	Commissioning of SCADA DMS system equipment's (including hardware and software to be deployed at DC, DCC)																				
e	Procurement of SCADA DMS system field equipment and IED (including																				

Sl. No	Activity Name	M 0	M 1	M 2	M 3	M 4	M 5	M 6	M 7	M 8	M 9	M 10	M 11	M 12	M 13	M 14	M 14	M 15	M 15	M16 TO Mxx	M17 To Mxx
	RTU, CMR, MFT etc)																				
f	Supply of SCADA DMS system field equipment and IED (including RTU, CMR, MFT etc)																				
g	Installation of SCADA DMS system field equipment and IED (including RTU, CMR, MFT etc)																				
h	Commissioning of SCADA DMS system field equipment and IED (including RTU, CMR, MFT etc)																				
7	**SCADA System Design Phase:**																				
a	SCADA System Design and Development																				
b	Software Additional Customization and Configuration																				
c	Solution Testing/Integration																				
d	User Acceptance Testing (UAT)																				

Sl. No	Activity Name	M 0	M 1	M 2	M 3	M 4	M 5	M 6	M 7	M 8	M 9	M 10	M 11	M 12	M 13	M 14	M 14	M 15	M 15	M16 TO Mxx	M17 To Mxx
e	Incorporation of UAT changes																				
8	**SCADA DMS Rollout Phase:**																				
a	SCADA system roll out at all 35 Sub Stations including integration with AMI, No Light, Billing, GIS, ERP etc.																				
9	**Go-Live Phase**:																				
a	Stabilization Support																				
b	SCADA System Acceptance																				
c	SCADA System Go-Live – All Locations																				
10	**O&M Phase:**																				
a	O&M Services support for 3 years post Go-Live including facility management and manpower services for:																				
b	Complete SCADA System																				
c	RTU and IEDs Installed at Substations																				
d	DC, DCC, NOC and SOC Civil and																				

Sl. No	Activity Name	M 0	M 1	M 2	M 3	M 4	M 5	M 6	M 7	M 8	M 9	M 10	M 11	M 12	M 13	M 14	M 14	M 15	M 15	M16 TO Mxx	M17 To Mxx
	Non IT Infrastructure																				
11	**Training and Capacity Building**																				
a	Continuous Training & handholding of Stakeholders.																				

Figure 4 – Project Execution Time Line

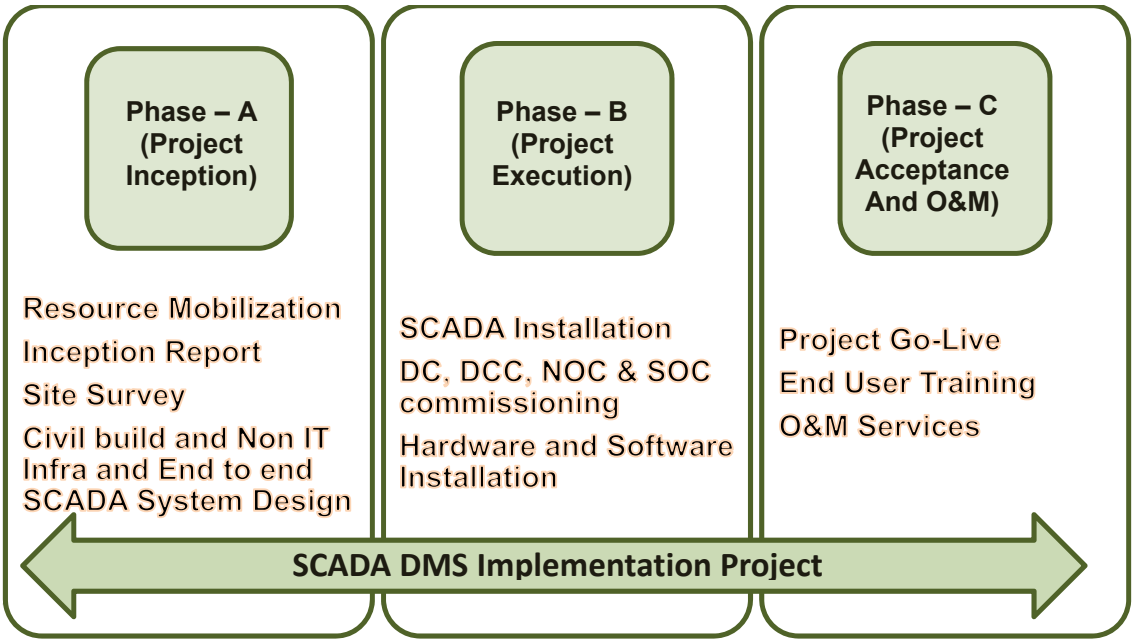


Figure 3 : Indicative Phases of the Project

1.6.1 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 field equipment installation including network connectivity feasibility, DC, DCC, NOC and SOC civil and Non- IT Infrastructure build and design (equipment locations etc.).

This phase will also include the Quality assurance of the supplied material and equipment though Quality Assurance (QA) testing and Factory Acceptance Test (FAT) in compliance to the Bid Document requirements.

Bidder shall carry out the task of overall system design, supply and testing of the communication network platform that can support multiple applications like SCADA DMS etc. over a single communications platform.

During this phase, the bidder shall carry out the activity of high level and low-level design of SCADA DMS system and submit the detailed design report to the NEA for approval.

1.6.2 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) DC facility and No- IT Infrastructure for DC, DCC, NOC and SOC
c) Hardware and Software for SCADA DMS to be installed in DC
d) RTUs and IEDs to be installed on the field.
e) All associated hardware and accessories for installation and commissioning of SCADA DMS system

Bidder will be responsible for physical installation of RTU and IEDs at around 30 locations (SS and switching stations), other communication equipment as required at the field level and integration and for correct integration of the installed feeder's and substations in the system. Installation of FRTUs and IEDs shall be carried out by the certified installer with the consent of NEA only. The field team deployed for RTU installation shall have a prior knowledge and experience of meter installation on the high and low voltage network topology and should be able to carry out the required installation process. When RTUs are installed, installer will check for communication/connectivity between Data center and intermediate communication entities. Connectivity check and monitoring of the network communication shall be performed for all the RTUs and field equipment installed in field.

This phase shall also include Installation and commissioning of Civil Build and Non- IT Infrastructure construction of DC, DCC, NOC and SOC that will house SCADA DMS systems and other IT systems of NEA and development of communication interface for the entire Kathmandu valley for field equipment connected with proposed optical fiber backbone/GPRS/GSM network connectivity of the NEA distribution network.

This project phase shall include the design, supply, installation, testing, and commissioning including additional capacity and license for SCADA system Software Solutions and hardware and software systems.

Once this Phase is complete and system is in production, SCADA system shall be roll out at all locations.

1.6.3 Project Phase C:

This phase shall include the SCADA system 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 overall SCADA system (including DC, DCC, NOC, SOC) is operational and Go-live criteria is achieved within the time duration of 24 months from the contract signing date, the O&M for the project 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.

SI shall provide the services for managing the SCADA system including hardware, software, networks installed and commissioned by SI for the utility to meet the availability requirement and SLAs as specified in the bid document.

1.6.4 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 DR Civil Build and Non- IT Infrastructure, SCADA DMS, 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.

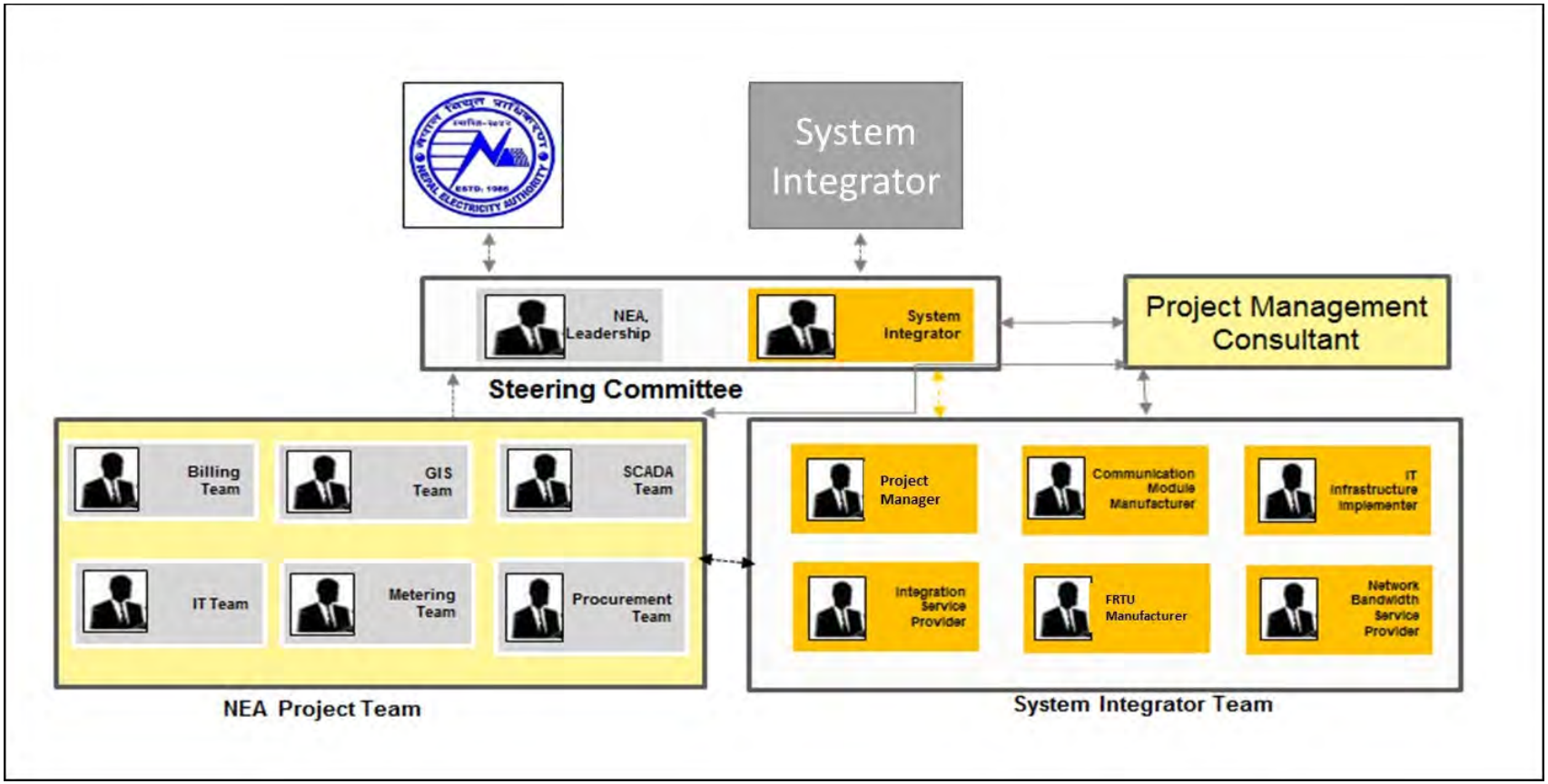


*Figure 4: **Indicative Project Governance team***

1.7 Minimum Indicative Manpower Requirement

1.7.1 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) In case, if any offshore resources are involved in the project, the bidder shall highlight the requirement and deployment for the needful.

f) NEA has all rights to reject any under qualified, low experienced resource at any time.

g) 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 projects in power sector and power distribution automation projects
2a	Site Engineers	Will be responsible for individual or multiple locations and would assist in the installation, commissioning and maintenance of the RTUs at various location of NEA.	B. Tech / BE having relevant minimum of 3 years of work experience in power distribution automation projects.
2b	Site Technician	Will be responsible for execution installation, commissioning and maintenance of the RTUs at various location of NEA or as per job assigned by Site engineer.	ITI or Diploma in Electrical having relevant minimum 3 years of work experience in electrical projects.

Sl. No.	Role	Responsibility	Desired Qualifications
Note: For O&M, for each 5 stations a maintenance crew comprising of 1 Site Engineer and 1 Site Technician is required. There will be 6 teams for 30 Substations and switching stations. These will be in 3 shifts and 1 additional team as reliever for each team. So, a total of 48 persons minimum are required for O&M comprising of category 2a and 2b.			
3	DCC Shift Engineer	Will be responsible for • overall operation monitoring of DCC as well as Substation parameters. • Preparation of operational reports. • Implementation of load scheduling and power balancing. • Interaction , liaisoning and maintaining the power flow balance with NLDC. • Maintaining of frequency and load forecasting • Any other suggestions to NEA regarding proper and reliable power flow.	B. Tech / BE Electrical having relevant experience of minimum 8 years in power distribution utility.
4	DCC Shift Operator	Will be responsible for • Operation monitoring of the assigned Substations. • Report Generation. • Maintenance of parameters and reporting to the field team for any defect. • Interaction , liaisoning and maintaining the power flow balance with NLDC and Customer Care executives. • Any other responsibilities assigned by Shift incharge.	Diploma having relevant minimum 3 years of work experience in IT projects.
5	Database Expert	Monitoring and maintenance of databases, installation of database software patches/upgrades, monitoring of database backups, database replication techniques, standardization, and implementation of databases to improve the management of production and test environments, support users by	B. Tech / BE / MCA / PGDCA / PGDBA having relevant minimum 5 years of post-qualification experience and database administration certificate. With at least 3 years of project experience in data base administration.

Sl. No.	Role	Responsibility	Desired Qualifications
		resolving problems with applications' databases. Monitor and allocate volumes, analysis of utilization and resources, performance tuning, monitor DB replication, coordination of system upgrades or fixes	
6	Storage Engineer	Monitoring and maintenance of storage and backup system at the Data center.	MCA / BE / B. Tech with minimum experience of 3 years as storage administrator
7	Utility Applications Expert	Responsible for towards analyzing application issue, user related issues, technical and acceptance related issues and work towards closure of them.	B. Tech / BE / MCA / PGDCA / PGDBA having relevant minimum 5 years of post-qualification experience. At least 3 years of project experience in utilities sector specially in operation and maintenance and overall functioning of power distribution.
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, 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	Network Administrator	Shall be responsible for end to end network management including monitoring and troubleshooting of network requirements.	MCA / B. Tech / BE / CCNP / CCNA / Industry Equivalent certification with minimum of 3 years of experience as a network administrator
10	Cyber Security Expert	Cyber security expert shall be responsible for the overall SCADA system security and will assist/implement latest cyber security technologies and measures	MTech/ B. Tech/ BE with CISSP/ CISA certified with mminimum of 5 years of post-qualification work experience. At least one IT Security audit experience.

Sl. No.	Role	Responsibility	Desired Qualifications
11	Facilities Management and Help Desk Coordinator	Responsible for coordinating helpdesk services at each location	B. Tech / BE / Diploma (IT or CS) with minimum of 2 years of experience as a Helpdesk Coordinator
12	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
13	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 DC to detail what equipment's are installed. His customer support responsibilities might include escorting customers through the DC, DC, NoC, SoC and DCC. on tours, responding to customer inquiries and coordinating with other OEM's and agencies. His administrative duties might include scheduling employee shifts, planning for capacity changes, maintaining corporate databases and ensuring compliance with government regulations.	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.
14	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 DC, NoC, SoC and DCC.	MCA / B. Tech / BE / Diploma (IT or CS or Electronics/Electrical) with minimum 3 years of experience
15	Computer/ Electronics Engineer	Responsible for setting up of DC, NoC, SoC and DCC and implementation of management tools and providing support for startup, comissioning, and	MCA / B. Tech / BE / Diploma (IT or CS or Electronics/Electrical) with minimum 3 years of experience.

Sl. No.	Role	Responsibility	Desired Qualifications
		integration of new IT equipment's in racks and provide support in connecting with Ethernet 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 DC, NoC, SoC and DCC	
16	Electrical Technician	Responsible for carrying out new installations and fault diagnosis work on new NoC, SoC and DCC electrical wiring, designing as per sitting plan and other infrastructure. It will involve carrying out power works, assisting in data centre installations and all general installation work. Candidates must be experienced in working with 3 phase power supply and have an understanding/exposure to the conversion from AC to DC power.	MCA / B. Tech / BE / Diploma (IT or CS or Electronics/Electrical) with minimum 3 years of experience.

Note: The mentioned resource requirements are minimum and indicative, however, the bidder shall propose project team and resources to meet the project Go-Live and SLA requirements.

2. General Requirements of SCADA System

This section describes the functions to be performed by the SCADA applications for distribution system for the project area. Bidders are encouraged to supply standard, proven & tested products that meet or exceed the specification requirements. This section describes the requirements of ISR functions also.

2.1 SCADA

The Bidders are encouraged to offer their standard products that meet or exceed the specification requirements. The software shall be able to work platform based on minimum 64-bit architecture. All periodicities and time intervals contained in the specification that define these parameters shall be considered as initial values to be used for performance purposes. The adjustments made to parameters by the user or programmers shall become effective without having to reassemble recompile programs or regenerate all or portions of the database.

The SCADA/DMS system applications are broadly classified into the followings:

- Data Acquisition from FRTUs at RMUs /sectionalized & FPIs.
- Time synchronization of RTUs, FRTUs & FPIs (if time sync is supported in FPI)
- Data Exchange among the contractors supplied SCADA/DMS system (in specified format (OPC/CIM-XML /ICCP/ODBC format) Model & Data exchange over IEC 61968-1 enterprise SOA based bus)
- Data Processing
- Continuous real-time data storage and playback
- Failsafe capability
- Network Status Processor
- Sequence of Event Recording
- Supervisory Control
- Remote database downloading, diagnostics & configuration.
- GIS adaptor (GIS Land base data, network model using GIS engines / adaptors supporting Native adaptors, CIM/xml Model for Distribution /Power system, using Model Exchange & Data exchange over IEC 61968-1 enterprise SOA based bus)
- Information storage & Retrieval (ISR)
- Data Recovery
- Advanced Data Visualization

The SCADA system shall have capability to accept data from the following sources:

- Telemetered data received from RTUs, FRTUs & FPIs
- Data received.
- Data exchange
- Calculated data
- Pseudo-data (Manually entered data)
- GIS land base data, network model using GIS engines/adaptors All input data and parameters, whether collected automatically or entered by a user, shall be checked for reasonability and rejected if they are unreasonable. All intermediate and final results shall be checked to prevent unreasonable data from being propagated or displayed to the user. When unreasonable input data or results are detected, diagnostic messages, clearly describing the problem, shall be generated.

All programs and all computer systems shall continue to operate in the presence of unreasonable data. Each of the SCADA functions is described below.

2.1.1 Fail-Soft Capability

The computer system in DMS shall be designed to ensure that the critical functions are given higher priority than the non-critical functions such that during conditions of excessive loading (beyond the specified requirement in this specification), which affects the operation of critical functions, the system shall enter into a fail-soft state in which performance requirements are relaxed to make optimal use of system resources. One such acceptable approach to fail soft implementation could be graceful degradation of data scanning to ensure availability of adequate resources for data processing and alarm handling between scan times.

2.1.2 Communication Protocol

SCADA system shall use the following protocols to communicate:

for RTU IEC 60870-5-104 protocol (existing if any to be communicated) for FRTU- IEC 60870-5 -104 and DNP 3.0 protocol

for FPIs - IEC 60870-5-104 and DNP 3.0 protocol

The protocol considerations shall be made in accordance to the system/ device to be interfaced. However, system shall have capability to interface using all necessary protocols as specified above for the devices that may be interfaced in future.

2.1.3 Data Acquisition

SCADA system shall acquire data from Remote Terminal Units (RTUs), FRTUs &FPIs

a) RTU & FRTU

The type of data to be acquired through RTUs, FRTUs shall include analog values, digital status data (Double point and single point indications) and SOE data from the substation, RMUs etc. Analog values like P, Q, F, each phase V, each phase I, each phase pf, and energy values (Export/Import KWh and KVARh) shall be collected by the RTU, FRTUs from the MFTs on Modbus protocol, Analog values such as station battery voltage, oil temperature, winding temperature, weather transducer data etc. shall also be acquired through RTU using analog input modules & suitable transducer, if defined in the RTU BOQ.

b) FPIs

Digital status in the form Fault protection indication viz O/C & E//F & in case also analog data such as Fault settings are remotely. The actual point counts & type of data acquired are given in the RTU, FRTU specification.

Polling Method

Digital status data from RTU shall be reported by exception and shall be updated and displayed within 4 seconds. Digital status data from FRTU & FPI shall be also be reported by exception and shall be updated and displayed within 6 seconds. Digital status data shall have higher priority than the Analog data. The system shall have dead band for data by exception. All analog values except energy values shall be reported by exception from the RTU, FRTU & FPI. The analog value, when reported by exception, shall be updated & displayed within 5sec from S/S & 10sec from RMU/sectionlizer locations at the control center. An integrity scan of all status & Analog values shall also be made every 10 minutes (configurable). The provision shall also be made to report analog values & status data periodically at every 10sec (user configurable), if required by the user. The time skew at SCADA/DMS control center, S/S, RMU, FPI shall not be more than 0.1sec at each location & latency shall not be more than 0.5sec for status. For analog data the time skew shall not be more than 1sec & latency shall not be more than 1sec for analog as per IEEE C37.1.

Energy values of 15-minute blocks shall be collected periodically from the RTU, FRTU at scan rate of 15 minute/1 hour (configurable up to 24 hours). Alternatively,

The contractor must assess & takes the network delay into consideration while designing the system so that the update time in normal & peak level of activities are met. The SCADA/DMS computer system shall also be able to collect all analog & digital data from its RTUs/FRTU/FPI on demand.

Apart from the periodic integrity scan, the integrity scan shall also be initiated automatically for an RTU/ FRTU/ FPI whenever the following situations arise:

a) Upon start-up of the system
b) RTU/ FRTU/ FPI status change is detected such as RTU/ FRTU/ FPI restart, Communication Link restoration
c) On demand by SCADA/DMS functions
d) On request by the user

The TCP/IP Communication for RTU, FRTU, FPI on public network shall be encrypted over SSL Security / VPN & the equipment should take control command from designated Master IP address only and no other IP. The RTU, FRTU, FPI & all TCP/IP devices that are on Public Network shall form a private VPN network with the SCADA Front End, through which encrypted data gets exchanged.

2.1.4 Adjustable Parameters

All the variable parameters of SCADA/DMS applications, which require adjustment from time-to- time, shall be defined in the database and shall be adjustable by system users. All periodicities and time intervals contained in the Specification that define these parameters shall be considered as initial values to be used for performance purposes. The adjustments made to parameters by the user or programmer shall become effective without having to reassemble or recompile programs.

2.1.5 Telemetry Failure

If data is not received from an RTU/FRTU/ FPI after a user-adjustable number of retries, each affected point in the SCADA system shall be marked with a 'telemetry failure quality code' and an alarm shall be generated. Telemetry failure of data can be due to failure of communication link, failure of complete RTU/FRTU/FPI or RTU/ FRTU module etc. Only a single alarm shall be generated if an entire RTU/ FRTU or its communication channel fails. In the event of telemetry failure, the last good value/status shall be retained in the database for each affected point. When telemetry returns to normal, the associated SCADA system shall automatically resume updating the database with the scanned data. The user shall be able to substitute a value in the database for any point that is experiencing telemetry failure which shall be marked with 'manual replaced' quality code in addition to the 'telemetry failure' quality code. The user shall also be able to delete any point (or entire RTU/FRTU/FPI) from scan processing. All deleted points shall be marked with a 'delete-from-scan' quality code.

The system shall have inbuilt self-diagnostics features to determine the RTU statistics for the time such as current/previous hour, current/previous day and other configurable time periods. The error display shall have following statistics such as percentage RTU error, RTU logs, bandwidth, good scan, bad scan etc and copy the error report to MS excel for data sharing.

Acquisition Modes

The following modes of data acquisition shall be supported:

a) Enable

When RTU/FRTU/FPI is enabled, the data is scanned in normal fashion and control command execution is allowed.

b) Disable

When RTU/FRTU/FPI is disabled, the data scanning & control execution is disabled. This is equivalent to" delete from scan "of complete RTU.

c) Test/Maintenance

Placing an RTU/ FRTU in test mode shall generate an appropriate event message. When an RTU/FRTU is in the test mode, the real-time database shall retain the last value from all points collected via the RTU/FRTU before it was placed in the test mode. The points shall be marked in the database with a quality code indicating that their source RTU/FRTU is in the test mode. All system displays, programs, data links, and other devices shall use this value. Supervisory control of points that are in the test mode shall not be permitted.

When an RTU/FRTU is removed from the test mode, a message shall be generated, the test mode quality code shall be removed from all points assigned to the RTU/FRTU, the database values shall resume updating on each scan, and any controls for the RTU/FRTU shall be enabled.

2.1.6 Time synchronization of RTUs

The SCADA/DMS system will be synchronized from the GPS based Time and frequency system. The SCADA system shall synchronize the time of all connected RTUs/FRTUs/FPI every 1 minutes (user configurable from 5 minutes to 24 hrs.) using time synchronization message in the IEC 870-5-104 protocol or NTP/SNTP. The servers /Workstations at SCADA/DMS control center shall be synchronized using NTP/SNTP. The time of DR center shall also be synchronized from the GPS based system installed in one of the SCADA/DMS control center in the state. The RTU shall have an internal clock. However, all the RTUs shall have a suitable interface for receiving synchronization signals from a local GPS receiver. The RTUs communicating over IEC-60870-5-104 shall be supplied with a GPS receiver for synchronization of RTU clock. The RTU shall synchronize its internal clock with the master station system clock when time synchronization messages are available and shall mark all the time stamped information/data as invalid when the RTU clock is not synchronized with the Master station. To achieve the RTU internal clock stability of at least 1 ppm, the contractor shall supply RTUs with GPS. The internal GPS should also provide positional information for asset management.

2.1.7 Data Exchange

2.1.7.1 SCADA DMS System with IT system

The SCADA/DMS System shall exchange data with ISR System & ISR System shall be the nodal interface with all IT System. The systems under IT System, shall exchange data with the ISR System, using Open Standards like CIM/XML & IEC 61968 Series Standards for Power System, OPC, ICCP/TASE.2., ODBC.

The GIS, AMI, SAS, transmission and generation Scada Systems shall exchange data with SCADA System over IEC 61968-1 SOA based ESB/Bus using CIM/XML Models for Power System using GIS Engine / Adapters supporting the standard Direct SQL/ODBC interfaces should continue to be supported for report generation and ad-hoc queries.

If utility was having GIS/ billing/customer/AMI/SCADA systems prior then interfaces may be selected accordingly viz ODBC/DDE etc using ASCII files. However, they shall provide system in compliance of the data exchange requirement specified in this para.

SCADA DMS control centre & SLDC

SCADA/DMS control center shall also exchange data using ICCP with National Load Dispatch Centre (NLDC) of the country. Data exchange shall also allow other information to be transferred report by exception but also configurable periodically, or on demand. It shall be possible to exchange at least the following data:

- real-time telemetered data of the interconnected network as per mutually agreed.
- Event /alarm lists

All other data shall be exchanged in file format via FTP.

- non-telemetered data of the interconnected network,
- calculated data of the interconnected network
- SOE data of the interconnected network
- historical data of the interconnected network
- scheduling data
- operator messages.
- Event /alarm lists

It is envisaged that the utility shall get the load forecasting & drawl schedules from SLDC & versa to execute planning of load distribution. In addition, status /measurement of interconnected network shall be able exchanged in both directions.

2.1.8 Output Requirements

The specific requirements for output results are described along with the other requirements of each function. However, all results that the user highlight to be important shall be stored in a form accessible for display and printing, if explicitly specified in the subsection

2.1.9 Reasonability of Data

All input data and parameters, whether collected automatically or entered by a user/programmer, shall be checked for reasonability and rejected if they are unreasonable. All intermediate and final results shall be checked to prevent unreasonable data from being propagated or displayed to the user.

When unreasonable input data or results are detected, diagnostic messages clearly describing the problem shall be generated. All programs and all computer system in DMS shall continue to operate in the presence of unreasonable data.

2.1.10 SCADA DMS Function Access

SCADA/DMS application functions shall be designated either as single user or multi-user function. For a single-user function, the user with access to the function must relinquish access to it before access can be granted to another user. For a multi-user function any number of users, up to the maximum designated for the function, may have access to the function simultaneously.

2.1.11 Critical & Non- Critical Functions

SCADA/DMS System functions are classified as Critical or Non-Critical function. Every critical function must be supported by sufficient hardware & software failure redundancy to ensure that no single hardware & software failure will interrupt the availability of the functions for a period exceeding the automatic transfer time defined in the specification.

Non-critical function may not be supported by hardware & software redundancy and can be suspended in case of non-availability of corresponding hardware.

The following functions are classified as Critical functions:

- All SCADA functions
- Information storage and Retrieval (ISR)
- All DMS applications
- Data exchange among the contractor supplied SCADA/DMS System.
- Web server applications, security applications.
- Processing of Requests from Operator Consoles

- Network Management system – the critical function requirement for NMS function may be implemented on redundant hardware either through failover process or by making the function available simultaneously on redundant hardware.
- Data Recovery function (DR)
- The following functions are classified as Non-Critical functions:
- Dispatcher Training simulator (DTS)
- Database modification and generation
- Display modification and generation
- Report modification and creation
- Data exchange with Remote VDUs, if any

2.1.12 Network Model Building and Testing Environment

The environment shall be used for making of all the changes in the model and shall contain servers for integration with external system on real time, such as GIS, SAP and AMI. The system shall support Automated GIS based DMS Network Modelling for real time updation of DMS network based on GIS updation. Besides, there shall be located servers for model testing and for simulation of operations.

2.1.13 Schematic /Geographical View

Master interface shall provide both types of distribution network presentation views: schematic and geographical network views, as well as single line view of all substations and technical data of elements. Multi-layered view will combine functionality of network display with SCADA-DMS-OMS Power Functions System, real-time operation and GIS. The system shall have a rich support for navigation, searching, and selection of network parts of interest.

The network view for SCADA, DMS and OMS shall be common so that operators can navigate seamlessly between SCADA single line diagrams of primary substations, geographic network views and outage details for efficient operation of the distribution network. From initial notification of an outage through prediction, crew assignment, fault isolation and return-to-normal switching, the operator shall be able to work from a single geographic network view with expanded information in tabular views.

Distribution network model database build and edit tool for DMS and OMS shall be single and incremental updates shall happen common for DMS and OMS applications to avoid multiple integration from existing GIS system.

To achieve vision of smart grid and common control center for distribution network, the OMS shall have tight integration with SCADA and DMS. All necessary information for each phase of the job shall be clearly presented in a way that allows the operator to manage each outage efficiently while also staying aware of other network activity such as Fault Location Isolation System Restoration (FLISR), Voltage VAR Control (VVC), alarm management etc. The unified geographic network view shall support:

SCADA operations such as supervisory control of field devices and tagging.

- DMS applications such as tracing, dynamic coloring, fault representation, placing of temporary devices such cuts, jumpers, etc. and
- OMS applications such as crew assignments, indication of outage calls, fault isolation and return to normal switching.

In Geographical view electric objects shall be drawn on geographical background of the city area. Geographical view could be used in the same way as schematic view, with additional advantage to see more information at the screen. Results of all SCADA-DMS-OMS Power functions will be available on both geographical and schematic views.

The Pilot window and user-defined bookmarks will provide easy navigation on the scheme. Background objects on the scheme could be organized into the layers. (e.g. "streets", "houses", "yards" etc.) From the Layers panel, user will be able to show/hide or adjust the intensity of layers of the scheme. Also, zoom level where the layers appear could be adjusted. In this way, user will be able to give focus to the area of interest, while keeping the other objects visible (but pale) for reference. The intensity of colors shall be transmitted to paper as well when the scheme is printed.

2.1.14 Temporary Elements

This functionality is intended for adding/removing temporary elements (TE) in distribution network and SCADA-DMS-OMS shall provide this option.

This mode will be initially intended for dispatcher but can be used for simulation purposes also. Following actions could be done:

- Inserting/removing section cut.
- Inserting/removing jumper
- Inserting/removing mobile generator.
- Inserting/removing grounding.
- Inserting mobile generator in MV/LV substation.

2.1.15 Data Exchange with other system in DMS

The Control Centre computer system in DMS shall be able to have bidirectional exchange of various types of data within the Employer-specified delivery times and response times using the assigned priorities specified in this section. Data exchange shall allow information to be transferred periodically or on demand between control center computer systems in DMS.

Bidder shall provide common user interface and common platform for SCADA, DMS and OMS applications. The operator should not feel a technical difference in graphical user Interface for SCADA, DMS and OMS. Also, there shall be provision for Single Sign On across the platform for all applications such as SCADA, DMS, ICCP, FEP and OMS. SCADA Area of Responsibility (AOR) shall be able to extend to OMS and DMS application

The data to be exchanged shall include real-time power system data (including telemetered, calculated and manually entered data) and all other information that is required to meet the functional requirements of the Specification. The other information shall include but shall not be limited to the transfer of user-defined text messages, reports, power system modelling information, substation graphic displays, tabular displays, operational data and software code.

The Data exchange function shall utilize all the channels in normal condition and shall be able to recover from failure of one or more communication channels unless the bandwidth is insufficient for data exchange at normal rate and periodicities.

2.1.16 Data Exchange Periodicity & Update Requirements

The data received by the SCADA system from the RTUs at the substations should be replicated on real time at the Data Recovery Centre of NEA.

The data exchange between the DCC, the NLDC, CCC etc. should happen on Real time basis.

2.1.17 Data Processing

The SCADA/DMS system shall prepare all data that they acquire for use by the power system operations and other applications. The data processing requirements shall apply to data collected from all specified sources.

- Real-time (also referred as telemetered) data received from control centers /IT system (data center, customer care, DR center and RTUs / FRTU / FPI etc)
- Calculated data
- Manually entered data
- Sequence of events data
- Alternate data sources

Analog Data Processing

Analog data processing shall be performed according to the requirements listed below. Analog- process-by-exception are not acceptable, however, system shall have the capability to do so.

Drift Detection

The FRTUs are provided with the feature of detection of drift in accuracy of Analog to Digital Converters and correction of the same. In case the drift is beyond the correction limits, the FRTU marks the raw data being sent to Control center with 'drift detection flag'. The Control center shall process this data and mark it with the Invalid quality code

Conversion to Engineering Units

Analog points that are transmitted to Control Centre computer system in DMS in raw data format shall be converted to engineering units before being stored in the database. This function shall include, as a minimum, the capability to perform the following conversion algorithm:

Value = (A * scanned valued) + B

A and B are programmer-adjustable constants assignable as database attributes on a per point basis. Analog points that are transmitted to the Control Centre in engineering units shall be converted to the native engineering unit format of the Control center before being stored in the database.

*float value same from the field. from FRTU, RTU. Don't need conversion.

Reasonability Limits Checks

All analog values shall be compared against high and low reasonability limits. The comparisons shall be performed at the scan rates of the analog values. The reasonability limits shall represent the extremes of valid measurements for the point's value. An alarm shall be generated the first time a reasonability limit violation is detected. The last valid value of the variable shall be maintained in the database and marked with a quality code indicating the reasonability limit violation. When data returns to a reasonable value, the new value shall be accepted and a return-to-normal message shall be generated. Reasonability limits shall be adjustable by the programmer.

Zero dead band processing

The SCADA system at control center shall process all analog values for 'zero dead band processing' to nullify in accuracies in the transducers output when the actual process value is zero. If the acquired value falls between the specified dead band range around zero then the processed value shall be clamped to zero else the actual value shall be considered for database and display purpose.

Limit Monitoring

All telemetered and calculated analog points shall be compared against limits that define various operating ranges for the variable.

Whenever a monitored point crosses a limit in the undesirable direction (i.e., away from the point's normal range of values), a limit alarm message shall be generated. The alarm message shall include:

a) Time of detection
b) Station name
c) Point name
d) Point value
e) Name of limit crossed
f) Value of limit crossed.

Whenever a monitored point crosses a limit in the desirable direction (i.e., towards the point's normal range of values), an exit alarm message shall be generated. The exit alarm message shall contain the same information as a limit alarm message except that it indicates that the alarm region bounded by the limit that was crossed has been exited. If multiple limits have been crossed since the last check, each limit crossed shall be reported.

All limit monitoring shall preclude annunciation of multiple alarms when a value oscillates about an alarm limit by utilizing an operator adjustable alarm dead band for each point.

The telemetered and calculated analog data shall be compared against high and low operating limits each time the value is scanned or calculated. For directional quantities (positive or negative) there shall be a set of three limits for each direction. The limits will represent increasing levels of concern and shall be named "Operational", "Alarm", and "Emergency" limits.

Further there shall be provision for definition of alternate limit sets, which shall be used to modify all the limits as a set for reasons such as Season (Summer and Winter) change.

It shall not be necessary to specify zero or infinity as an operational or emergency limit. Limit comparison shall be carried out only with respect to the specified limits.

The user shall be able to temporarily override an in-use limit by entering a new value. When the user overrides a limit, it shall be marked with an override quality code on all displays. The override value shall be recognized, and any display, report, or log containing the value of the overridden limit shall include it as such. An override value shall be used instead of the permanent value until the user removes the override condition, selects an alternative limit set, or the system is re-initialized. A limit override summary shall be if lists all overridden limits.

Any change in alarm states resulting from a change in limit value shall be reported. The feature for dynamic modification of Alarm threshold limits of a parameter based on the value of another parameter shall be available.

Rate of change /Gradient

All telemetered and calculated analog points shall be also processed for rate of change of / gradient processing, if defined that point for such processing in the database. An Alarm for over shoot & event message for return to normal shall be generated.

The rate of change shall be calculated periodically for each assigned point, by dividing the points values at the beginning and the end of the period into the length of the period. Filtering shall be applied so that single scan excursions do not cause an alarm. The result shall be saved as a non- telemetered database point. All the requirements that apply to calculated points, such as limit checking,

Sign Conventions

The sign conventions for the display, data entry, and reporting of real and reactive power flow shall be used universally by all SCADA/DMS functions:

Table 1: Sign Conventions

Equipment	Flow convention
Bus	• real power into bus: Negative • reactive power: same as real power
Generator Transformer	• real power low to high side: Positive • reactive power: same as real power
Substation/Distribution Transformer	• real power high to low side: Positive • reactive power: same as real power
Loads	• real power into load: positive • reactive power into equipment: Positive

Accumulator Processing

The system shall be able to store accumulator history. Storing accumulator history shall be provided with a method in which that stores data only once per hour and in other method that stores data each time new data enters the system. It shall be possible to use the two methods concurrently for any pulse accumulator, making it possible to maintain two records for data that are read more than once an hour.

Pulse Accumulator Data

It shall be possible to collect pulse accumulator data on the hour and every quarter hour. A freeze command shall be issued at the time of collection to ensure consistency of all FRTU accumulator readings.

The accumulator data shall be converted to engineering units using the following algorithm: Data Base Value = A * (Scanned Value - Scanned ValueN-1) where A is a signed constant, definable by the programmer for each accumulator point in control center computer system. Scanned Value is the raw telemetered value for the current collection time. Scanned ValueN-1 is the raw telemetered value for the previous collection time. The calculation shall accommodate accumulator rollover. If an accumulator reading cannot be acquired due to a communication channel or other failure, the stored data base value shall be assigned as zero and marked with a telemetry failure quality code. When a subsequent reading is successful, the corresponding data base value shall be calculated as the total accumulation since the last successful reading.

2.1.17.2 Digital Input (Status) Data Processing

Each state of a digital input point shall be associated with the state of an actual device. The number of bits that will be used to define the state of a device is defined in the RTU/FRTU Specification. A status point shall be defined as being either legal or illegal, and normal or abnormal:

Illegal state: The first check on a new input to a digital status point is the legality check. If the new state is illegal, then the old value shall be left in the database and marked old with relevant quality code such as telemetry failure etc.

Abnormal state: If the new state is legal, it shall be checked to see if it is among the normal states defined for the point. If not, the status point shall be marked as abnormal. While abnormal, it shall appear in the summary display of abnormal conditions/ off-normal summary

Alarm checking: Each new value shall be checked to see if transitions into that state are to be alarmed. If so, and if no control action is pending on the status point, then an alarm action shall be triggered.

It shall be possible to associate each state i.e. engineering conversion of a digital input point with the state of an actual device. The following digital input data types shall be accommodated as a minimum:

(a) Two-state points: Points with two states. The following pairs of state names shall be provided:

(1) Open/Closed
(2) Tripped/Closed
(3) Alarm/Normal
(4) On/Off
(5) Auto/Manual
(6) Remote/Local
(7) On Control/Off Control

(b) Three-state points: Points with three positional states. Any of the state combinations listed in (a) above shall be supported with a third, typically, in transit state. The programmer shall be able to designate any combination of "bits" in the data representation of each three-state point as an undefined state.

The programmer shall also be able to designate the in-transit state as open or closed for use by the Network Status Processor and the Power System Model Update functions.

(c) Momentary change detection (MCD) points: These points may incur multiple operations between scans and shall support all states defined in (a Based on the state of the point from the previous scan, the state of the point from the current scan, and the state of the "change" indication from the current scan, the following intermediate operations shall be detected:

Previous Scan State	**Current Scan State**	**Intermediate Operation**
closed	open	Open
open	closed	Close
closed	closed	open/close
open	open	close/open
closed	open	open/close/open
open	closed	close/open/close
closed	closed	None
open	open	None

Alternatively, the SCADA system shall be able to process status changes of a status point which happen in quick succession (say within 1 second) and are reported by the FRTU as separate events. These multiple status changes shall be logged as separate events. The Operator shall be indicated about the multiple status change.

Un-commanded changes in state of telemetered and calculated digital input points shall be alarmed. The alarm message shall include:

(a) Time of detection

(b) Station name

(c) Point name

(d) Description of field action (e.g., alarm messages for all intermediate operations associated with MCD points)

(e) Current state name.

Commanded changes initiated by supervisory control shall not be alarmed, but rather shall cause an event message to be generated. The event message shall include the same information as an uncommented change-of-state alarm message, except that the event shall indicate that the state change resulted from supervisory control.

The programmer shall be able to define the points to be monitored, the time for monitoring, and the allowable number of operations per time. If the allowable number of operations is exceeded within a time, an alarm shall be issued.

2.1.17.3 Calculated Data Processing

Each control center computer system shall can perform the following calculations at the indicated rates. The results shall be incorporated into the database as calculated data available for display. The database variables to be used for arguments and the mathematical functions to be used as operations shall be definable interactively at a console as well as by the programmer using database creation and maintenance procedures.

If a calculation attempts to divide by zero, the calculation shall be aborted and the point's last good value shall be retained in the database and assigned a quality code denoting the questionable data condition.

Sys call in database should be able to calculate online.

2.1.17.4 Generalized Data Calculations

The user shall be able to define calculated analog values using database points as the arguments and mathematical functions as the operators. Functions such as addition, subtraction, multiplication, division, maximum value, minimum value, average value, count, square root extraction, exponentiation, trigonometric functions and, logarithms shall be provided.

The user shall be able to define calculated status values using database points as arguments and combinational logic functions that include the, logical & comparative operators such as AND, inclusive OR, exclusive OR, and NOT.

Suitable rules or operators (such as multi-level parentheses) shall be provided to indicate the sequence of operations in the calculation. The execution of a defined calculation or portion of a calculation may, if so chosen, be conditional on the state of a telemetered or calculated status value, or the comparative relationship of two values. The comparative operators like, Less Than, Greater Than, Less Than or Equal To, Greater Than or Equal To, and Equal To shall be provided.

2.1.17.5 MVA and power factor calculations

MVA and power factor values shall be calculated from MVA = SQRT (MW2 + MVAR2) and MW/MVA, respectively.). The calculation shall be performed at the fastest scan rate of the component data.

2.1.17.6 Megawatt and Megavar Integration

Selected megawatt and megavar values in the control center computer system database shall be individually integrated at their scan rates over each quarter of an hour for each hour of the day. The quarter-hourly energy values shall be summed for each hour to compute hourly energy quantities. If any quarter-hourly data is substituted manually, the hourly value shall be assigned a corresponding quality code.

2.1.17.7 Rate of Change

The rate of change of variables shall be calculated using the following formula that filters the rate of change via exponential smoothing:

New Rate = A * Old Rate + (1 - A) (New Value - Old Value)/Time Interval

New Value and Old Value refer to the selected variable, A is a user-specified constant between 0 and 1, and Time Interval is the applicable scan rate.

2.1.17.9 Substation Topology Processing

The SCADA /DMS system shall be provided with a Substation topology processor function. This function shall can analyze the open/closed status of switching devices, such as breakers and disconnectors, to define the configuration of the substation for display. The energization of lines, transformers, bus sections and generating units shall be determined so that the associated displays may correctly show the status of these power system elements. The configuration shall be re- evaluated and updated whenever a switching device status change & analog value change beyond dead band is detected.

2.1.17.9 Quality Codes

Quality codes indicate the presence of one or more factors that affect the validity of a data value. All quality codes that apply to a data value shall be maintained in the database for that data value. The quality of the calculated value shall be the quality of its "worst" component of its arguments. The presence of a quality code on any of the component data values shall not disrupt the calculation using that value. Results of calculations that are manually overridden by the user shall be denoted with a quality code that can be differentiated from the propagation of a manual replaced quality code from one of its component values. At least the following data quality codes preferably as the following single letter code shall be provided. However, distinct symbols /shapes after approval from employer may also be used.

Table 2:Quality Codes

Quality code	Code	Reason
Telemetry Failure (RTU Link)	T	Telemetry has failed
Manual Replaced	M	Manual updation
Delete from Scan (RTU/point)	D	User disabled the scan of the of data/point
Questionable data	Q	Analog values of the de- energized elements
Calculated	C	Calculated data
Estimated	E	Estimated data from state estimator
Limit Override	L	Limits are overridden

Primary /secondary source	P/S	Primary or secondary source
Reasonability Limit Exceeded	R	Value beyond reasonability limit
Alarm Inhibit	A	Alarm processing is inhibited
Test or maintenance mode	X	Point is in test /maintenance mode

2.1.17.10 Data Validity Tests

Data validity tests shall be performed and shall generate an alarm when data changes from valid to invalid. A return-to-normal message shall be generated when the data again becomes valid. The tests shall be performed as follows:

(a) Bus imbalance - The algebraic sums of telemetered, calculated, and/or manually entered MW and Mvar values for devices connected to a bus shall be compared to a system-wide tolerance provided values are available for all such devices.
(b) Open device test- The MW and Mvar flows for switching devices that are open shall be compared to a system-wide tolerance.
(c) Redundant branch MW and Mvar flows shall be compared for differences greater than a system-wide tolerance.
(d) Redundant bus voltages shall be compared for differences greater than a system-wide tolerance.
(e) Redundant frequency values (for the same electrical island) shall be compared for differences greater than a system-wide tolerance.

The system-wide tolerances shall be specified by the programmer. When invalid data is detected it shall be marked in the database with a quality code to denote the data is questionable.

2.1.17.11 System Load and Interchange Monitor

The megawatt load and net interchange (both import and export) for each power system shall be monitored, at prevailing scan rates, and compared to the maximum and minimum values for the current day, week, month, and year. When a new maximum or minimum value is detected for any of these periods, the new value, date, and time shall replace the corresponding data for that period.

System megawatt load and interchange (both import and export) maximum and minimum values shall be retained by the control center computer system in DMS per the following table:

Table 3 :Retention Period

Period	**Retention**
Daily	Current and Previous Days of the Current Week
Weekly	Current and Previous Weeks of the Current Month
Monthly	Current and Previous Months of the Current Year
Yearly	Current and Previous Two Years

Frequency Variations Index

FVI is a performance index representing the degree of frequency variation, from the nominal value of 50.00 Hz, over a specified period.

Frequency Variation Index (FVI)=

$$10 \times \frac{\sum_{i=1}^{N} (fi-50)^2}{N}$$

Where

fi: actual frequency in Hz at i th time.

N: number of measurements over the specified period

Line and Transformer Loss Calculation (where applicable)

Line and transformer active and reactive power losses shall be computed for all lines and transformers where adequate data is available to permit such computations. Examples of adequacy are:

a) Active power flow measurements at both ends are available for active power loss calculations
b) Active and reactive power flow and voltage measurements at one end are available and computations shall include the parameters of the line and transformer models, such as resistance, reactance, susuptance, and transformer tap position.

Max/Min value Calculations

For calculation of the max/min value of analog points, the time periods (duration) of interest shall be defined by the user and max/min value shall be identified/calculated from all samples collected during the duration of interest.

The duration of interest shall be configurable on a system wide basis from 5 to 60 hours insteps of 5 minutes. The results shall bear the time tag of the time at which the Maxima and Minima occurred. These calculations shall use the Realtime clock for time tagging.

Also, the ability to calculate and display the Maxima and Minima values of user-selected telemetered and calculated analog points shall be provided. The user shall be able to enter the point names and the duration (period) of interest.

Average value calculations

For calculation of the average value of an analog point, the sampling frequencies of the point and the time periods (duration) of interest shall be defined by the user.

Average of value over duration of interest = Sum of values/No. of samples

The duration of interest shall be configurable on a system wide basis from 5 to 60minutes in steps of 5 minutes. The results shall bear the time-tag of the time at the start of the interval. These calculations shall use the real-time clock.

2.1.18 Network Status Processor

The control center computer system in DMS shall be provided with a network status processor function. This function shall can analyze the open/closed status of switching devices, such as breakers and disconnects (isolators), to define the configuration of the power system in DMS for monitor, and video projection system display. The energization of lines, transformers, and generating units shall be determined so that the associated displays may correctly show the status of these power system elements. The configuration shall be re-evaluated and updated whenever a switching device status change is detected.

There shall be no limitation on the number or the configuration of switching devices required to define the energization status of lines, transformers, and generating units. It is preferred that Network Status Processor use the same input data used by Power System Model Update. The need for Employer to define Boolean equations or to undertake special data base maintenance efforts to support analysis of the energization and service status of devices by Network Status Processor is unacceptable.

2.1.19 Redundant Data Source Processing

Some data in the SCADA/ DMS database may be obtained from more than one source. Typically, the “best available” source of the data shall be chosen for use in displays, reports, and other functions.

This feature of choosing the best available source is “redundant data source processing” function. The inputs to redundant data processing function shall be called “arguments”, and the chosen source is called the “resultant best value.” The arguments may be telemetered values, calculated values, manually entered and values generated by SCADA/DMS functions. The resultant best value shall be stored in the SCADA/DMS database and shall be used by the SCADA/DMS system functions.

When defining the calculation for a resultant best value, the user will rank the arguments in a priority order. The resultant best value shall be determined by selecting the “best available” from among the arguments. The highest-ranking argument with a valid value shall be stored as the result. If none of the arguments have a valid value, the highest-ranking item with the best quality shall be stored as the result.

Users shall be able to override automatic selection and manually select any argument. Restoration of automatic redundant data processing shall require manual action by a user. Automatic and manual changes of the selected argument shall be reported as an event.

Alternate source of Data

The system shall have capability to accept multiple data sources by defining as main & secondary. Normally, data from normal source will be considered. In the event of non-availability of primary source, data from secondary source shall be considered & once primary source is healthy, it shall switch back to primary source. There shall be an indication for primary /secondary source in displays, reports etc. Suitable alarm shall be generated in the event to change from primary to secondary & vice versa. Alternate source of data can be defined for certain critical points in the database.

2.1.20 ODBC Interface

The SCADA system shall have an ODBC (Open Database Connectivity) interface which shall allow all the real-time data (point) to be accessible by Personal Computers (PCs) running Microsoft- Windows applications. The value and the quality code of the real-time data shall at least be accessible through ODBC.

2.1.21 Continuous real-time data storage and playback

All real-time data (Analog and status) from Realtime system shall be continuously stored in Information storage and retrieval ISR system for at least a two-year period. as and when it is received in the SCADA database from the RTUs.

It shall be possible to playback above stored data on single line diagram and network diagram for a time window of any time (configurable in seconds /minutes) by defining Start and End date and time. Playback shall be played in Video Cassette Recording (VCR) style controls and shall allow the playback of de-

energization of lines. It shall be possible to illustrate all types of process data (historical and real time) as trends – input and output data, binary and analogue data. The trends shall be displayed in graphical form as column or curve diagrams with a maximum of 128 trends per screen. Adjustable time span and scaling ranges must be provided. The system shall have the ability to have an unlimited number of windows on a monitor. Trend shall have the ability to superimpose two different time frames in a single window for comparison. It shall be possible to set a different sampling rate for playback than the sampling rate for data storage. The continuous data storage system shall support timestamps stored with millisecond resolution for Sequence of Events (SOE) for post fault analysis.

The users shall be able to select the time window of interest for archival of data in the ISR system for future retrieval and playback in SCADA system. This archived data shall be transferable in RDBMS database tables of ISR system for generation of tabular displays and reports. The data historian shall have failover capabilities for system redundancy to ensure high-availability and system shall be scalable easily by adding additional servers (add nodes online).

2.1.22 Sequence of events recording

The Sequence-of-events (SOE) data is the time-oriented listings of status change events collected from all RTUs/FRTU/FPI. The SOE data shall bear the time stamp as stamped by the RTUs/FRTU/FPI. It shall be collected by the control center computer system in DMS for subsequent review by relevant user personnel. The time difference between SOEs shall be resolved within one millisecond intra-FRTU and ten milliseconds inter-FRTU supplied under the contract. The system shall display the sequence of events with two different times, source time and system time for analyzing the events for fault analysis.

SOE data collection process shall not interfere with periodic data acquisition or supervisory control actions. The SOE events shall be logged once each day, when the SOE buffer is approaching capacity, and on demand by the user.

The Contractor must integrate the SOE data from the existing RTUs and the new RTUs such that the user is able to perform sorting based on time, RTU Station and Devices.

The description of each SOE shall include the database description name, device state, the date and the time (to the nearest millisecond) of each event.

SOEs shall be displayed and logged in reverse chronological order. The user shall be able to select the display of SOE by RTUs/FRTU/FPI. At least latest 1000 SOE data shall be available for display.

The facility to transfer SOE data from DCC to higher level Control Center (NLDC), from DR to DCC and from DCC to DR shall be provided. This transfer of SOE data shall be done either using ICCP or some other established method. It shall be configurable in Automatic and Demand mode. However, initially SOE data transfer to higher level Control Center shall be configured in Automatic mode.

All SOE data collected from all RTU/ FRTU/FPIs shall be stored in daily RDBMS database of ISR system.

2.1.23 Supervisory Control

The operator shall be able to request digital status control, set-point control and raise/lower control on selected points and analogs using Select check before operating (SCBO) Sequence.

An appropriately authorized user of a control center computer system shall be able to control the operation of field devices connected to RTU /FRTU /FPI. The devices that can be controlled from any console shall be determined by the partitions assigned to that console. It shall be possible to assign many controllable devices in one group and then control all the devices by executing a single control command on the group. The Control center computer system shall in turn execute the supervisory control to the various devices in the group as required by the communication protocol sequences.

A control action shall require a confirmation-of-selection-prior-to-execution response. Initiation of the control execute step shall occur after the user confirms that the correct point and control action have been selected. After the user initiates control execution, the interlocks defined for that device shall be checked, the RTU /FRTU /FPI shall be addressed, and verification that the correct point has been selected at the RTU /FRTU /FPI shall be obtained, and then the control action shall be executed.

If, after selecting a point, the user does not execute the control action within a programmer-adjustable time-out period, or if the user performs any console action other than completing the control action, the selection shall be cancelled and the user be informed by a message.

The user shall not be prevented from requesting other displays, performing a different supervisory control action, or performing any other user interface operation while the master station waits for a report-back on previously executed control actions. The device undergoing control shall be highlighted by the Computer system with a different color /graphical attribute so that it is identifiable by the user. This highlighting shall be present till the receipt of desired feedback from the device.

The system shall process supervisory control commands with a higher priority than requests for data from the FRTU data acquisition function. It shall be possible to exercise supervisory control from Data centers for its FRTUs and from MCC for all FRTUs.

Functional requirements for the various types of supervisory control are given below. A supervisory control request shall be sent from control center only after the controlled point was checked for proper conditions. The request shall be rejected by the System if:

1. The requested control operation is inhibited by a tag placed on the device; The device or S/S in local manual control mode
2. An Uninitialized, Telemetry failure, delete from scan, manual replaced, Test/maintenance, or Manually Entered data quality indicator is shown for the device;
3. The Operating Mode/ user permission of the workstation/console attempting control does not permit supervisory control
4. The device is already selected for control request or control execution is from another workstation / user/window /console or control request is progressing
5. Time out after selection
6. The device is not subject to supervisory control of the type being attempted
7. Rejection of a control request from control center shall occur before any transmission is made for control purposes. A control rejection message shall be displayed for the Dispatcher

2.1.23.1 Digital Status Control

A digital control output results in the activation of an output relay in a RTU. Different commands shall be possible for these digital status controls. Successful completion of the control request shall be recorded as an event. Failures to complete shall be handled as specified in UI section. Control requests shall be canceled and the selection of the point shall be terminated when the user cancels a request, does not perform the next step of the control procedure within the selection time-out period from the previous step of the procedure, or the request is rejected.

Switching Devices

The user shall be able to select and operate any controllable switching device. Controllable switching devices will be of either the two-state or three-state type, e.g., circuit breakers or motor-operated disconnects (isolators).

Capacitor Banks

The user shall be able to control capacitor devices. The procedure for controlling these devices shall be the same as that of a switching device except that any supervisory control action must be inhibited for a

programmer-adjustable time after the capacitor/ reactor device has been operated. A message shall appear if an attempt is made to operate the device prior to expiration of that time & dispatcher is required to give command after expiration of inhibited time.

Tap Changing Transformers (where applicable)

SCADA system shall have the capability to raise and lower the on-load tap position of the transformers from SCADA control center through supervisory commands.

Depending on system conditions, the user may raise or lower the tap positions of On Load Tap Changing (OLTC) transformers. OLTC's tap position need to be monitored if supervisory control action is to be exercised. OLTC tap position input shall be acquired as an analog value. Tap excursions beyond user-specified high and low limits shall cause the master station to generate an alarm.

Supervisory control of OLTCs shall only be permitted when the transformer's control mode is Supervisory. All attempted invalid control actions shall be rejected.

For supervisory operations, the initial selection and control of the transformer for a raise/lower operation shall follow the (SCBO) Sequence. Upon receipt of the raise/lower command, the RTU will immediately execute the control action. It shall not be necessary for the user to re-select the transformer for additional raise/lower operations; the user shall only have to repeat the desired number of raise/lower commands, which shall be executed immediately. Normal scanning functions shall not be suspended between the times that repeated raise/lower commands are issued.

The user shall be able to cancel the operation or have it automatically cancelled by the master station after a programmer-adjustable time elapses after the last raise/lower command. This multi-step procedure as described below

a) The RAISE and LOWER pushbuttons shall be displayed.
b) The command shall be launched as soon as RAISE or LOWER is selected. The Raise and Lower buttons shall not be replaced by a single Execute button. The RAISE/LOWER pushbuttons shall continue to be displayed, and it shall be possible to initiate these controls repeatedly without reselection of the controlled point, provided that the execution of the previous control command has successfully been completed.
c) The RAISE/LOWER pushbuttons shall remain available until either (a) the dispatcher clicks the CANCEL button or (b) the control times out due to inaction by the dispatcher.
d) A separate timeout period, adjustable in the range of up to 120 seconds, shall be provided for incremental control. The timer shall be reset and start counting again whenever a RAISE or LOWER command is issued.

Successful completion of incremental control shall be recorded as an event. However, failure of incremental control, including failure to achieve the intended result, shall be alarmed.

2.1.23.2 Set Point Control

The SCADA/DMS shall provide the capability to issue set point control using SCBO procedure to field equipment the SCADA/DMS shall transmit a numerical value to the device being controlled, to indicate the desired operational setting of the device.

2.1.23.3 Auto Execution Sequence/Group Control

The Auto execution sequence function shall permit multiple supervisory control commands to be programmed for automatic execution in a predefined sequence. The dispatcher shall be able to execute this sequence. Commands to be supported shall include:

a) Time delayed

b) Pause & until a user commanded restart or step execution
c) Jump to other sequence on certain conditional logic
d) Manual Entry.

After executing a supervisory control action, the SCADA/DMS shall pause to obtain an indication of a successful control completion check. If the control completion check is not received, or does not have the expected value, the SCADA/DMS shall terminate the execution of the sequence and shall declare an alarm. Apart from waiting for control completion checks, and unless there is an explicit command for a delay, such as a “Pause” or “Stop” command, the SCADA/DMS shall not introduce any other delays in the execution of a sequence. No limit shall be placed on the number of Auto execution sequences, which may execute in parallel. At any time during the execution of a list, the user shall be able to stop further execution via a cancel feature.

2.1.23.4 Control Inhibit Tag

The user shall be able to inhibit or enable supervisory control on any device. A tag symbol indicating the control inhibit conditions shall be displayed next to the device on all displays where the device is presented. The programmer shall be able to define the following 4 tag types with up to 6 tags per device:

a) Tag symbol and color to be displayed (Red, Green, Yellow, White)
b) Tag priority
c) Type of controls that shall be inhibited by the tag (e.g., open only, close only, open and close, or information only (no control inhibits)).

Only the highest priority tag shall be displayed. Any combination of tags shall be supported, including multiple tags of the same type. The combined effect of multiple tags shall be to inhibit a type of control if it is inhibited by any of the tags.

When a tag is placed on a device, the user shall be prompted to enter a four-digit tag number and a comment of up to 60 characters. A list of all active tags on a device shall be conveniently accessible to the user. The list shall indicate the date and time the tag was placed on the device, tag type, tag number, and the user-entered comment for each active tag. Tag removal shall be permitted from this list and from any display where the Tagged device is shown. An event message shall be generated each time a control inhibit tag is placed or removed.

2.1.23.5 Control Action Monitor

The response to all control actions shall be verified by monitoring the appropriate feedback variable. A report-back timer (the duration dependent on the type of device) shall be initiated when the command is issued. At least ten timer periods shall be supported, any of which may be assigned to any device. System-wide timer periods of 10to 60 seconds and individual-device timer periods of 1 to 60 seconds shall be supported and shall be adjustable in steps of one second.

The user shall be provided with an indication that a control action is in progress and, subsequently, a report of the result. If the control was unsuccessful, an alarm shall be generated that states:

a) the control message exchange was not completed successfully,
b) the device failed to operate,
c) or the device operated but failed to achieve the desired result (e.g., following a close control action, a three-state device operates from the open state, but remains in the transition state).

If the control was successful, an event message shall be generated noting that fact.

For commands issued as part of a group control or load shed operation, the successful completion of all device control actions shall be reported via a single message. If the operation is unsuccessful, the user shall be informed of those devices in the group that failed to operate

2.1.23.6 Power Flow Check Before Control

A "select power flow" option shall be available to the user prior to the requested supervisory control execution. When this option is selected by the user, a system-wide power flow shall be executed based on the latest state estimate and desired supervisory control action. The purpose is to advise the user of any potential problem due to the desired control action. The following features shall be included:

(a) Check-Before-Closing: The following shall be displayed:
(1) Initial voltage across open device
(2) Initial angle across open device
(3) Initial power system frequency difference across open device
(4) Load and generation pickup due to device closure
(5) Voltage violations due to device closure
(6) Overloads due to device closure.

(b) Check-Before-Opening: The following shall be displayed due to device opening:
(1) Load and/or generation drop
(2) Voltage violations
(3) Overloads
(4) Electrical islanding
(5) Bus splitting
(6) Power system frequency.

Control Permissive Interlocks

It shall be possible to define the interlocks at SCADA level as necessary for control actions. It shall also be possible for operator to bypass the interlock which shall be recorded as an event message with user ID information.

Remote Data base downloading, diagnostics and configuration

The SCADA/DMS system shall be able to download database run diagnostics & create/modify /delete configuration/ parameterization from centralized control center locations to RTU/FRTU/FPI etc using ASDU/ messages of respective protocols or file transfer

CIM & IEC 61850, Smart Grid Interface Requirements

The system shall utilize the required standards for (IEC 61968 and IEC 61970 – to be removed) compliant interface with external systems viz. SLDC, LDCs, OMS, SAP, CMS, etc. The relevant interface servers with data table structure must be provided and defined. (The system shall enable export of all data and messaging interfaces (via a CIM-XML interface – to be removed) and shall utilize modelling from standards (IEC 61968 – to be removed) as appropriate. (The profiles supported should be CDPSM (Common Distribution Power System Model) and CPSM (Common Power System Model). Messaging interfaces shall be based on model neutral interfaces based on the IEC 61970-40X series for access to real-time and historical data and use the IEC 61968-3 and IEC 61968-9 standards for messaging interfaces that are model dependent for network operations and metering respectively – to be removed.)

The IT Systems Interface & the SCADA/DMS Systems Interface shall be so provided using relevant (CIM/XML & IEC 61970/61968 – to be removed) standards such that, a 3rd Party application service

provider can integrate the two systems, or add a 3rd IT or SCADA/DMS System easily, without having to know specific Database Tables / Information of the other system.

Any Change in the electrical network system which will be captured in GIS database of the utility shall be automatically added/modified to SCADA system. eg: A new asset addition, should be able to be exchanged through Model Information between the IT System, and SCADA/DMS System without programming or configuration effort automatically & adjust and accept the Model and re-configure its databases, and should provide updated results.

SCADA/DMS Vendors shall provide CIM/XML Adapters for ICCP, OPC or ODBC for their System and CIM/XML Model repository for data and model exchange with IT Systems.

Further, system shall be able to interface with IEC61850 (GOOSE & GSSE Models) & provide an Independent 3rd Party modeling tool that can support multiple vendor IEC 61850 IED's and create IEC 61850 SCD files. To enable to Migrate to Smart Grid, the SCADA/DMS Systems shall support the following:

a) Security – The SCADA/RTU/FRTU Network must be secure over SSL secure layer, and should be implemented as a VPN. Secure adapters between end nodes on public networks should be considered with IPSec or VPN.
b) Interface to AMI/AMR System where-by DSM can be implemented over CIM/XML Interfaces
c) The SCADA CFE should be able to integrate with Smart Grid gateway that supports ICCP / IEC 61850 / IEC 60870-5-101/104// DNP3, DLMS & ANSI C12.18/21 & IEEE C37.118

2.2 Information Storage and Retrieval

Information Storage and Retrieval (ISR) function shall allow collection of data from real-time SCADA/DMS system and storing it periodically in a Relational database management system (RDBMS) database as historical information (HI) data. This includes storing of data such as SOE, status data, Analog values, calculated values, Energy values etc. Programmer shall also be able to set storage mode as by exception in place of periodic storage.

The ISR shall have retention of minimum 5 year measured data & 2 years for events data at actual scan frequency of data received - for analysis, display, trending and report generation through specific / necessary software tools though self or third-party interface.

The ISR system shall also be used for mass storage of data/files such as DMS application save-cases, Output results of DMS applications, Continuous real-time data of selected time window etc. Following reports shall be available in ISR function:

a) Circuit breaker status report
b) Real-time Database Snapshot report s
c) Hourly Data report s
d) Missed Hourly Data Storage
e) Hourly Data Calculations
f) Daily Energy Data report
g) Load priority report
h) SOE data table

Subsequently, the data shall be retrieved for analysis, display, trending and report generation. All stored data shall be accessible from any time regardless of changes made to the database after storage of that data (e.g., it shall be possible to retrieve stored data for a variable that no longer exists in the SCADA/DMS computer system through backups on storage medias viz. LTO disks etc and initialize study-mode DMS functions with stored data on the corresponding power system model).

The addition, deletion, or modification of data to be collected and processed shall not result in loss of any previously stored data during the transition of data collection and processing to the revised database.

It should be able to compress data, and should have 100% retrieval accuracy. However, the retrieval of compressed historical streams should be of the same performance levels as normal SCADA retrieval. The ISR should be able to interface over ICCP, OPC, ODBC and CIM/XML to external systems for analytics over SOA / ESB for Integration with IT Systems, over the Enterprise Services Bus & SOA Architecture provided as part of IT SRS. The ISR system shall act as the real interface between SCADA and IT System, where-by the real-time operational system is not affected with a transaction processing system like IT, and the IT Integration efforts will not in any way effect the real-time operationally of SCADA/DMS System.

In ISR should also support ad-hoc queries, and define display and report formats for selected data via interactive procedures from operator workstations. Formatted reports and responses to user queries shall be presented in alphanumeric or graphical format on either operator workstations or printers at the option of the user. Procedure definition facilities shall be provided for activities that will be frequently performed. SQL-based language shall be used for selecting, retrieving, editing, sorting, analyzing, and reporting ISR data stored. The selection and sorting criteria shall include time tags and ranges, station names, point names, equipment types, status values, text string matches on selected data fields etc and combinations of these criteria.

It shall be possible to reload any IS&R archival media that has been removed from IS&R and access the archived data without disturbing the collection, storage, and retrieval of IS&R data in real-time. The ISR system shall also be used for mass storage of data/files such as DMS application save-cases, Output results of DMS applications, Continuous real-time data of selected time window etc.

2.2.1 Circuit breaker status Table

The ISR function shall maintain a table in RDBMS database where real-time status of all Circuit breakers, in case of RMU isolators also along with the associated quality codes shall be stored. The change of status of any breaker shall be updated in this table as soon as the change is detected by the SCADA system. This table shall contain additional information such as date & time of tripping, cause of tripping, Expected duration of outage etc. Some of the causes of tripping could be Supervisory control by user, Protection tripping, Tripping / closing by DMS applications. Information on expected duration of outage shall be taken from schedules for DMS application such as Load shed application etc. For expected duration of outages due to protection tripping, the same shall be user enterable field. Such daily tables for two months duration shall be stored on auxiliary memory. Tables for the previous day shall be backed up to LTO drives.

The ISR function shall transfer the information available in the "Circuit breaker status table" as defined above, to the Customer Care center using SOA/Enterprise Service Bus supplied by ITIA, over CIM/XML Models, or CIM/XML OPC/ICCP Adapters / Interfaces. The complete Circuit Breaker Information shall be transferred to Customer care center on demand & by exception along with the associated quality codes and additional information associated with the CB.

2.2.2 Real-time Database Snapshot Tables

At the end of each 5 minutes, the following real-time snapshot data shall be stored in RDBMS in Real-time Database Snapshot tables:

a) All telemetered analog values and Calculated values for all tele-metered analog points (at least maxima & minima with associated time and average values). Energy values are not envisaged for storage in Data snapshot tables.
b) All status values with time stamp

All the above values as specified above in (a) & (b) shall be stored along with their associated quality code. The periodicity of the snapshot shall be user adjustable to include 5, 15, 30, and 60 minutes.

Data Snapshot tables shall be created on daily basis. Such daily tables for two months duration shall be stored on auxiliary memory. Tables for the previous day shall be backed up to LTO disk by the user at 10AM of every day. The ISR function shall prompt the user through a pop-up window to inform the user for taking the backup. The pop-up window shall persist till user acknowledges the same. In addition to that data can be stored on offline storage device.

The user shall also be able to initialize the study-mode power system analysis functions from stored snapshot data.

2.2.3 Hourly Data tables

At the end of each hour information as defined below shall be included in the hourly data tables, in RDBMS database form:

a) Selected analog values along with their associated quality codes
b) Selected status values along with their associated quality codes
c) Results of hourly calculations for selected analog points (at least maxima & minima with associated time and average) along with their associated quality codes.
d) In addition to above a separate hourly energy data table exclusively for energy values (Export and Import Active and reactive Energy values for each feeder) shall be created in ISR along with their associated quality codes.

Hourly data tables shall be created on daily basis. Such daily tables for two months duration shall be stored on auxiliary memory. Hourly data table for the previous month shall be backed up to LTO disk by the user on the 10th of every month. The ISR function shall prompt the user through a pop-up window to remind the user for taking the backup. The pop-up window shall persist till user acknowledges the same.

2.2.4 Missed Hourly Data Storage

The programmer shall be able to independently assign any one of the following processing for each hourly value to be executed when the value is missed and cannot be acquired prior to the storage of hourly values.

a) Store zero and a telemetry failure quality code for each missed hour.
b) Store the last good data value, with a questionable data quality code, for each missed hour.
c) Temporarily store zero with a telemetry failure code for each missed hour.

When the next good hourly value is obtained, divide that value by the number of hours since the last good value was obtained and insert this value, with a questionable data quality code, for all hours with missed data and the first hour that good data was obtained as is the case for energy values.

2.2.5 Hourly Data Calculations

The programmer shall be able to define calculated values using stored hourly data and constants as operands. The calculations shall allow the carry-forward of data from one day, week, or month to the next. The results of all calculations shall include quality codes derived from the quality codes of the operands. The following calculations shall be provided:

a) Addition, subtraction, multiplication, and division
b) Summation of an hourly value by day, week, and month: The running total of the summation for the current day, week, and month shall be updated each hour and made available for display.
c) Maximum and minimum of a value over a programmer-definable time, and the time the maximum or minimum occurred
d) Average of a value over a programmer-definable time

2.2.6 Daily Energy Data table

The daily energy data table shall be generated for storage of daily energy values for 15-minute blocks / one-hour blocks of a day & shall be stored for each feeder on daily basis along with quality codes. This daily energy data shall be exchanged with the Billing system in Data center & DR, master billing center on daily basis and on demand. This table shall be created on daily basis. Such daily tables for two months duration shall be stored on auxiliary memory. Daily Energy data table for the previous month shall be backed up to LTO by the user on the 10th of every month.

2.2.7 Load priority table

ISR system shall maintain a Load priority table containing information such as breaker name, number of consumers connected to each Breaker and Load priority of each Breaker. This table shall be updated by the Billing system in Data center.

SCADA /DMS control center operator can also assign priorities in load priority table & the priorities assigned by the Billing system in Data center & DR may be accepted/ rejected by him. There shall be suitable alarm/event message including user ID for such activity. The table information shall be used by various DMS applications**.**

2.2.8 SOE data table

ISR system shall maintain SOE data table which shall store the SOE data for complete distribution system. It shall be possible to sort the table by Time, Date, Substation name/, feeder/line name, device name etc. using SQL commands. This table shall be made on daily basis. Such daily tables for two months duration shall be stored on auxiliary memory. For sizing of table, daily 4 changes per SOE point may be considered. All CBs, protection and alarm contacts shall be considered as SOE. Tables for the previous day shall be backed up to LTO disks by the user at 10AM of every day.

2.2.9 Data exchange with billing system (Data center & DR center)

The ISR function shall provide daily energy values along with associated quality codes to Billing system once in a day and on demand. SCADA/DMS System shall have the provision to import/export energy values with Billing system at data center/DR. This information of Load priority in ISR system shall be updated by Billing system at data center /DR shall be used by DMS applications. Further data from snapshot table shall be transferred to IT system. This data exchange shall be done using SOA / Enterprise Services Bus already provided by SI, over Open XML Models like CIM/XML, or over ICCP / OPC/ODBC.

2.2.10 Data Exchange with Customer Care System

The ISR function shall transfer the information available in the "Circuit breaker status table" as defined in this chapter, to the Customer Care center using SOA/Enterprise Service Bus supplied by SI, over CIM/XML Models, or CIM/XML OPC/ICCP /ODBC Adapters / Interfaces. The complete Circuit Breaker Information shall be transferred to Customer care center on demand or Changed Information shall be send along with the quality codes and additional information associated with the CB.

2.2.11 Data Exchange with GIS system:

SCADA Systems over CIM/XML Models using GID to IEC 61968-1 will be used by SCADA/DMS & other IT Systems for getting network information, customer and interconnection information.

The GIS will interface using CIM/XML adapters to other applications. SCADA will have model aware adapters to read from GIS network model repository, and update its own models. The system shall utilize an IEC 61970 and IEC 61968 compliant interface. The system shall enable export of all data via a CIM-XML interface per IEC 61970-452 and IEC 61970-552-4 and shall utilize modelling from IEC 61968-11 as appropriate.

Data exchange shall be over model neutral messaging services and CIM/XML data exchange for real- time or RDBMS will be used. The following standards as applicable will be used to achieve the above requirements: Messaging interfaces shall be based on model neutral interfaces based on the IEC 61970-40X series for access to real-time and historical data and use the IEC 61968-3 and IEC 61968- 9 standards for messaging interfaces that are model dependent for network operations and metering respectively

The Graphic data import from GIS systems shall support native formats of GIS systems which shall be potentially used for data import. All Technological addresses (TAs) shall be automatically assigned within the system to the tags linking the graphic data to the attribute data in the GIS, the attribute data shall be loaded into the SCADA data base and the display diagrams shall be generated. The Graphics exchange between GIS and SCADA should happen over IEC-61970-453 Scalar Vector Graphic based XML representation

The complete network model including data of electrical network e.g. line (i.e. length, type of conductor, technical of conductor & transformer etc, land-based data. Suitable GIS interface adaptor to enable the compatibility with GIS software/ data format /model shall be provided. The Graphic data import from GIS systems shall support native formats of GIS systems which shall be potentially used for data import. The data shall be transferred on global & incremental basis on manual request & automatically, once in a day The DMS shall automatically move elements that overlap one another in congested areas so that the operator can clearly see each segment of the network in the geographic view. In addition, the system shall automatically move and scale annotation text that come from GIS so that it is visible the user's current display SCADA/DMS in the geographic view. The system shall include tools to edit annotations /text & symbology placements in geo – referenced displays, substation and distribution network. It shall be possible to import related reference layers such as streets, buildings, poles etc and other background information.

All Technological addresses (TAs) shall be automatically assigned within the system to the tags linking the graphic data to the attribute data in the GIS, the attribute data shall be loaded into the SCADA /DMS data base and the data /text shall be displayed on SCADA/DMS diagrams if viewed in GIS mode shall display GIS in background with zoom, pan, scaling & UI navigation techniques in synch with SCADA/DMS system

displays. The GIS Network Model shall be exposed to the IT and SCADA Systems over CIM/XML Models using GID to IEC 61968-1 Enterprise Bus. This model repository will be the single model authority for the entire Utility network to be used by both IT & SCADA/DMS Systems. This repository is maintained by the GIS System, and will be used by SCADA/DMS & other IT Systems for getting network information, customer and interconnection information.

2.2.12 Historical Information (HI)

The data stored in the ISR system shall support the following retrieval capabilities:

a) The user shall be able to view and edit HI data on displays/Forms and reports. The user shall be able to edit HI data, request recalculation of all derived values, and regenerate and print any daily, weekly or monthly HI report for the current and previous month.
b) The user shall be able to view tabular trend and graphical trend of multiple data points simultaneously by specifying the start date and time, the end date and time, and the time between displayed samples. The duration of viewable tabular trend and graphical trend could be up to 24 hours. The features of Tabular/graphic trend are mentioned in the specification for User interface.
c) The HI retrieval shall expose the ISR Data over SOA / Enterprise Services BUS Supplied by ITIA, over CIM/XML, ICCP or OPC ODBC Interfaces / Adapters. (D) The retrieval shall provide 100% accuracy and fidelity of data

2.2.13 System Message Log Storage and Retrieval

The system message log, which shall consist of the chronological listing of the control center computer system alarm messages, event messages and user messages shall be stored for archival and analysis. Each entry shall consist of the same time tag, dynamic information, user identification, and text that are displayed on the Alarm Summary or Event Summary display; the same text that appears on the user message line; or the same time tag, contingency information, and violation information that is stored in the security analysis message log.

Alarm system shall support sort-out/grouping of various columns either by adding or deleting (through drag and drop) any fields in the alarming field of an attribute. Operator shall be able to attach a note, photo or a document to any alarm or a group of alarms in the system. The system shall allow filtering of alarms in a parent-child arrangement. Operator shall be able to select any set off alarms either continuous or randomly and paste to any Microsoft applications such as MS Excel or Word etc for proving reporting function to an operator.

System message log data for all days of last 2 months shall be stored on auxiliary memory and shall be available online. System message log data for the previous months shall be automatically/Manually archived on storage device (Hard disk etc.) by the user for which ISR function shall prompt the user every hour with suitable message to remind user for taking the backup on the 10th of every month.

This message shall be disabled once the backup is taken.

System message log data storage shall be sized for up to 200,000 entries per month. Facilities to sort and selectively display and print the contents of the system message log shall be provided. The user shall be able to select the display of system message log entries based upon the following sort keys and combinations of these keys:

a) Alarms: The user shall be able to select a subset of alarms based on alarm category and alarm type.
b) Events: The user shall be able to select a subset of events based on the action of specific users and conditions detected by specific power system operations functions.
c) User message line messages
d) Security analysis messages: The user shall be able to define a security analysis message log that contains a time-stamped notification of the first detection of any violation due to any contingency

solved by the real-time contingency analysis function and a corresponding notification of when that violation is relieved.

e) Station
f) Device type
g) Device
h) Time: Both specific time periods, and relative time periods (for example, twelve hours prior to the current time) shall be supported.

A display shall be provided to permit the user to define the selection criteria. The user shall be able to direct the selected subset of system messages to a specific monitor or printer from this display. When the display is requested by the user, all selection criteria shall default to the last set of criteria defined by that user.

The programmer shall be able to define and schedule the printing of up to ten system message log reports based upon programmer-specified sets of selection criteria. The programmer shall also be able to direct the immediate printing of messages that meet a set of selection criteria as the messages are generated.

2.2.14 Mass storage of data/file

The ISR system auxiliary memory shall be sized for mass storage of data/files for the followings as minimum:

a) 200 save-cases for each DMS application
b) 200 Output results of each DMS applications
c) Continuous data storage and playback for two years.

2.2.15 Data recovery function (DR)

The DR function is a repository of system build up software of all areas where SCADA/DMS is going to be installed. One-year online backup shall be available at this location with data pertaining to each area i.e. system build ups shall be available of each town separately so that the same can be utilized upon setting up newer system after disaster. The data related to network model of SCADA/DMS control center of each area shall be sent to DR center periodically once a day & upon user request. The data shall be configured to be sent globally & incremental. All logs, data model etc & necessary interfaces that are essential for complete system build up shall be stored at DR center. All requisite data which is build the system from scratch shall be transferred to DR. An alarm shall be generated & send to SCADA/DMS control center upon attaining user defined threshold e.g. 80% for storage at DR center

2.2.16 2.20 Advanced Data Visualization

SCADA/DMS Graphical User Interface (GUI) shall support following features to create dynamic dashboards, simply by selecting, dragging and dropping the points on a dashboard template shall be provided. The dashboard shall have displays like Speedometer, Bar chart, pie chart, line graph etc. The speedometer display shall also indicate the limits of the analog values. Dashboards shall be definable by the end user without requiring the involvement of an administrator or programmer. The system shall support import/export of dxf and dwg drawings into SCADA system. The system shall support advanced data visualization and user interface, including 3D rendering and dashboards for Real-time Business Intelligence, Situational awareness support, including contouring and data profiles.

2.3 DMS & Supporting Functions

2.3.1 General Requirements

This Section describes the Distribution Management System (DMS) applications & other supporting applications that are required for SCADA/DMS System. The DMS applications shall utilize the data acquired by the SCADA application. Distribution management System Software shall include the following applications. Utilities shall select /all or certain applications according to the need & characteristic / profile of the electrical network & future part of SMART GRID in the project area. Main functionalities typically include:

2.3.2 SCADA/DMS Power Functions Systems in DMS

- Network Connectivity Analysis(NCA)
- State Estimation (SE)
- Volt-VAR Control(VVC)
- Load Flow Applications. (LFA)
- Load Shed Application (LSA)
- Fault Management & System Restoration. (FMSR)
- Loss Minimization via Feeder Reconfiguration(LMFR)
- Load Balancing via feeder Reconfiguration. (LBFR)
- Distribution Load Forecasting. (DFL)
- Switch order Management.
- Operation Monitor(OM)
- Work Order Management
- Under Load Switching
- Relay Protection
- Energy Losses
- Operational Losses
- Reliability Analysis
- Optimal Network Reconfiguration
- Network Planning

2.3.3 Other Supporting Functions

- Dispatcher training Simulator (DTS)

2.3.4 Contractor's Standard Product

The bidders are encouraged to supply standard, unmodified products that meet or exceed the Specification requirements.

2.3.5 Graphical & Tabular display requirements for DMS functions

A network overview display of the distribution system with substations, feeders color coded by voltage shall be provided. This display shall present the distribution system in a graphic format. Telemetered and calculated values like active and reactive power flows etc shall be displayed with direction arrow. Lines, Loads, transformers etc that have exceeded their loading limits shall be highlighted. Stations shall be depicted by suitable symbols which reflect the presence of alarms.

Cursor selection of a station symbol shall result in display of the associated Single line diagram for that station. "What if "analysis shall be included to visualize network & verify the impact before an action is taken by dispatcher. For all switching actions which dispatcher must execute manually/step by step shall have the option to simulate switching operations to visualize the effect on the distribution network using what if analysis.

All DMS result tabular displays shall have capability for sorting by name and calculated parameters. The solution prescribed by DMS application shall consider & identify & sort the following as minimum

The solution prescribed by DMS application shall consider & identify & sort the following as minimum

a) Remote controllable circuit breaker with capability to interrupt fault currents
b) Non-remote controllable circuit breaker with capability to interrupt fault currents
c) Remote controllable circuit breaker with no capability to interrupt fault currents
d) Non-remote controllable circuit breaker with no capability to interrupt fault currents.
e) Remote controllable disconnector
f) Non- remote controllable disconnector.

g) Fuse Ground/ Earth switch etc
h) Sectionalizer

2.3.6 Distribution Network Model

The DMS applications shall have a common model for the project area comprising of primary substation feeders, distribution network and devices with minimum 10 possible islands, which may be formed dynamically. All DMS applications shall be able to run successfully for the total distribution system with future expandability as envisaged under the specification. The following devices shall be represented in the model as a minimum:

a) Power Injection points
b) Transformers
c) Feeders
d) Load (balanced as well as unbalanced)
e) Circuit Breakers
f) Sect ionizers
g) Isolators
h) Fuses
i) Capacitor banks
j) Reactors
k) Generators Bus bars
l) Temporary Jumper, Cut and Ground
m) Meshed & radial network configuration
n) Line segments, which can be single-phase, two-phase or three-phase and make up a distribution circuit.
o) Conductors
p) Grounding devices
q) Fault detectors
r) IEDs

Operational limits for components such as lines, transformers, and switching devices

All DMS applications shall be accessed from graphic user interface through Operator consoles as defined in this specification. Reports, results and displays of all DMS application shall be available for printing at user request.

Population and maintenance of the distribution network model should be possible by using the database maintenance tools to build the database from scratch. In case the required data already exists within the Employer's corporate Geographic Information System (GIS), the DMS database functions should leverage this effort by providing an interface/adaptor to extract GIS data using the CIM international standard IEC 61970/61968 and automatically generate the complete Network Operations Model. The data extracted should include network device information, connectivity, topology, nominal status and non-electrical data such as cable, land base data etc. Further Land base data can be sourced from GIS in Shape files or DXF.

The extraction process should comply with the international standard CIM data descriptions. The CIM standard is maintained by the IEC (Technical Committee 57, Working Group 14) and is used for a wide range of purposes. The extraction process should be independent of the real-time network management system. Any GIS model should be extractable to build the network model regardless of the supplier or internal schema. The extraction should also allow incremental updates & global transfer with no need to bring the system down or even fail over. The model should support extraction on a per-station basis and must be fully scalable from a single zone substation to the largest distribution networks. SCADA/ DMS should be able to present geospatial data even when the link to the source GIS at the data center/DR is not available.

The user interface supporting the database will provide updated data directly to display geographic and/or schematic views of the network.

The model should support multiple geographic coordinate sets for each device so that, if available, the network can be displayed in custom geo-schematic formats. The network views may also include various levels of detail depending on the zoom level. Information such as land-based data (provided as a dxf file, shape file etc) may also be displayed as required.

An interface with the already existing Geographical Information Systems shall be developed using interoperability features between the DMS and the installed GIS.

Each of the two systems shall keep its own specificity, and shall be used for what it has been designed: the SCADA for the real-time data acquisition, control and processing, the GIS for the maintenance of the network construction and geographic data.

The interface shall be developed to obtain a maximum benefit of the two systems use. It shall be implemented while maintaining the SCADA/DMS and GIS integrity as individual systems. It is of the utmost importance that the two systems remain able to operate separately.

The required functionalities for this interface shall cover the two following aspects: The transfer of specific real-time data from the DMS into the GIS data-base. The possibility to navigate easily from one system to the other through the user's interface.

Data exchanges shall be made through the Control Center LAN/WAN. Bidder shall demonstrate its incorporation capability to the main GIS Vendors through a dedicated reference list or provide and support standard interfaces to GIS.

2.3.7 Network Connectivity Analysis

The network connectivity analysis function shall provide the connectivity between various network elements. The prevailing network topology shall be determined from the status of all the switching devices such as circuit breaker, isolators etc that affect the topology of the network modelled. NCA shall run in real time as well as in study mode. Real-time mode of operation shall use data acquired by SCADA. Study mode of operation will use either a snapshot of the real-time data or save cases. NCA shall run in real time on event-driven basis. In study mode the NCA shall run on operator demand.

The topology shall be based on

a) Tele-metered switching device statuses
b) Manually entered switching device statuses.
c) Modelled element statuses from DMS applications.

It shall determine the network topology for the following as minimum.

a) Bus connectivity (Live/ dead status)
b) Feeder connectivity
c) Network connectivity representing S/S bus as node
d) Energized /de-energized state of network equipment's
e) Representation of Loops (Possible alternate routes)
f) Representation of parallels
g) Abnormal/off-normal state of CB/Isolators

The NCA shall assist operator to know operating state of the distribution network indicating radial mode, loops and parallels in the network. Distribution networks are normally operated in radial mode; loops and/or parallel may be intentionally or inadvertently formed.

A loop refers to a network connectivity situation in which there exist alternative power flow paths to a load from a single power source. A parallel refers to a topological structure in which a load is fed from more than one power source. Parallel paths often result in circulating currents and such operating conditions need to be avoided. All loops/parallels in an electrical network shall be shown by different colors in such a way that each is easily identifiable.

Abnormal state of CB/Isolators means these devices are not in their Normal OPEN or CLOSED position.

Alarms shall be generated when presence of abnormal switches, De-energized components of network and of Network loops / parallels is detected.

Tracing

NCA function shall also have the capabilities of network tracing when requested by the dispatcher. Dedicated colors shall be used for feeder and circuit tracing and when information available is not complete or inconsistent. The trace shall persist through subsequent display call-ups, until the operator explicitly removes it or requests another trace. In addition, at the bottom of the geographic view the number of transformers and customers passed by the trace are shown.

a) Feeder tracing - This feature shall aid dispatcher to identify the path from a source to all connected components by same color.
b) Circuit tracing- This feature shall enable operator to select any device and identify the source and path by which it is connected through the same color.
c) Between Tracing: This feature shall enable the operator to select any two components of the network and shall able to trace all components connected in between them.
d) Downstream Trace – from a selected circuit element the trace identifies all devices that are downstream of the selected element. In the case where a downstream trace is performed on a de-energized section of the network, the trace highlights all devices electrically connected to the element.

Temporary Modifications

The NCA will allow temporary modifications at any point in the distribution network to change the network configuration, to isolate faults, restore services or perform maintenance. A Summary shall list the jumpers, cuts and grounds that are currently applied. The function is performed by the NCA and is implemented locally within the client software and has no effect on the operations model or other clients viewing the network.

Cuts

Cuts facilitated in any line segment in the network. The cut may be applied to one or more available phases of the conductor. The cut could also be applied as a temporary switch inserted in the line.

a) The cut must be given a name or id number for identification, which is displayed as a label on the geographic network view.
b) It should be possible to select the position of the label relative to the cut symbol.
c) The position can be altered after the cut has been placed.

Once placed the cut symbol can be selected and switched on and off by the operator in the same way as a standard disconnect switch. Cuts can also be tagged.

Jumpers

Jumpers are a means of providing a temporary, switchable connection between two points on the network. The operator should be able to select two points and place the jumper with relevant details. The initial state of the jumper may be set to open or closed. The jumper popup automatically defaults to show the phases

available for connection between the two points but other partial or cross-phase connections may be made if required. The popup shall warn the operator about abnormal connections such as not all phases being connected or the nominal voltage being different at the two connection points. Once the jumper has been placed the switch symbol in the center can be selected and switched open or closed. The topology of the network model is updated accordingly. There is no restriction on the placement of jumpers between lines connected to different feeders or different substations.

Temporary connections between phases on the same line segment, known as a phase jumper shall be supported. This can be used in conditions where one phase is deenergized and it is desired to restore customers by energizing the dead conductor from one of the live phases.

Temporary Grounds

Temporary grounds should only be placed, for obvious reasons, on de-energized sections of a line. These grounds represent the mechanical grounding of lines for safety purposes during maintenance or construction.

A temporary ground may be placed on one or more of the available phases. It must be given a name and addition information can be included in the description field. If a line segment is re-energized while a temporary ground is still applied, the ground will be automatically removed.

Reports and Displays

The reports and displays shall be generated indicating the followings as a minimum:

a) Abnormal switches in tabular display
b) De-energized components of network in tabular display
c) Presence of loops & parallels on network displays
d) Un-served/ disconnected loads (loads affected due to tripping of CBs) in tabular displays
e) List of temporary jumpers/cuts /grounds.

2.3.8 State Estimation

The primary function is to determine network state where SCADA system monitoring is directly envisaged. The State Estimation (SE) shall be used for assessing (estimating) the distribution network state. It shall assess loads of all network nodes, and, consequently, assessment of all other state variables (voltage and current phasors of all buses, sections and transformers, active and reactive power losses in all sections and transformers, etc.). Firstly, the symmetrical (per phase) and asymmetrical (three-phase) load of all nodes in the radial or weakly meshed MV network, which are not remotely monitored, that is not directly covered by the SCADA System shall be using evaluated Load Calibration. SE represents the basic DMS function, because practically all other DMS Analytical Functions are based on its results. This is the unique function dealing with the unobservable load of the actual network, which is not directly covered by the SCADA System.

Function is used for balanced and unbalanced networks. The function is based on an algorithm specially oriented towards distribution networks, with low redundancy of real time, remotely monitored data, the deficiency of real time data must be compensated with historical data. Beside the parameters of network elements, the real-time data consists of:

a) Actual topology, transformers tap changer position, etc.
b) Voltage magnitudes of supply point and other nodes in the network.
c) Current magnitudes (active and reactive power) at feeder heads.
d) Current magnitudes (active and reactive power) from the depth of the network.

The historical data of the network consists of:

a) Daily load profiles – current magnitudes and power factors, or active and reactive powers for all load classes (types, for example: industrial, commercial, residential), for all seasons (for example: winter, spring, summer, autumn), for e.g. four types of days (for example: weekday, Saturday, Sunday and holiday).
b) Peak-loads for all distribution transformers and/or consumers (peak-currents and/or peak powers) and/or monthly electric energy transfers across all distribution transformers (consumers).
c) SE function shall run in all cases from the range of networks where all historical data are known, but also in networks with no historical data available (based on parameters of the network elements). Also, according to users setting, the SE function shall be able to run:
d) With or without verification of telemetered measurements.
e) With manual or automatically processing unobservable parts of network.
f) With or without fixed measurements.

This shall have real time & Simulation mode both. In the first one, the function shall be used for estimation of the current state. In the Simulation mode, the function is used for estimation of the desired state (e.g. any state selected from the saved cases).

The SE algorithm shall consider into account the non-availability of real time data and compensates them with historical data, pseudo and virtual measurements, to achieve the minimal set of input data necessary for running a consistent Load Flow.

The SE algorithm shall consist of the next important steps:

a) Pre-estimation – It shall be based on the historical data of the network: daily load profiles, peak-loads for all distribution transformers and/or consumers, etc. This step shall give pre-estimated states of considered MV networks.
b) Verification of measurements– It shall be obtained from artificially redundancy of measurements (too small number of measurements and notable main number of pseudo measurements obtained from first approximation). This step shall consider two sub-steps: (a) in sighting evidence bad measurements, (b) verification and/or correction all permanent measurements. In this step, incorrect measurements shall be corrected or discarded.
c) Load calibration – The function shall distribute the load to the busbars of the MV network based on the set of verified measurements and historical data. Also, Load calibration shall deal with consumers specified directly through their current/time diagrams i.e. load curves as well as with consumers with constant consumption. The function shall run even any of these data are not available. It shall be designed in such a way that the quality of results of the function running increases directly with the amount of given data.
d) Load Flow calculation – This shall be the next function in the specification based on the loads assigned in the previous steps

Input/output

Beside the network element parameters, main inputs for the functions consist of above noted real time and historical data. In the case of the function running in the Simulation mode, the real-time data must be replaced with the corresponding data from the saved cases or forecasted ones. Main outputs of the function are estimation of:

a) Voltage magnitudes in the entire network.
b) Current magnitudes and power factors for all network elements.
c) Loads of all MV and LV consumption buses.
d) Losses of active and reactive powers in the entire network, by each supply transformer or feeder.

Beside those results, output of SE function is tabular report, also. In this report measurement verification results are presented those results are:

a) Pre-estimated and estimated values of measurements.
b) Minimal and maximal expected values of measurement.
c) Quality of each measurement.
d) Deviation measured values from estimated and pre-estimated values.

2.3.9 Volt –VAR control (VVC)

The high-quality coordination of voltages and reactive power flows control requires coordination of VOLT and the VAR function. This function shall provide high-quality voltage profiles, minimal losses, controlling reactive power flows, minimal reactive power demands from the supply network. The following resources will be considered for voltage and reactive power flow control:

a) TAP Changer for voltage control
b) VAR control devices: switchable and fixed type capacitor banks.

The function shall propose the operator solution up on change in the topology of the network switching. The function shall consider the planned & unplanned outages, equipment operating limits, tags placed in the SCADA system while recommending the switching operations. The functions shall be based on user configurable objectives i.e. minimal loss, optimal reactive flow, voltage limits, load balancing. These objectives shall be selectable based on feeder, substation & group of substations or entire network. The despatcher shall have the option to simulate switching operations and visualize the effect on the distribution network by comparisons based on line loadings, voltage profiles, load restored, system losses, number of affected customers. The solution shall identify /sort the different type of switches that are required for operation i.e. remote /manual etc.

Modes of operation

The VVC function shall have following modes of reconfiguration process:

a) Auto mode
b) Manual mode

The despatcher shall be able to select one of the above modes. These modes are described below:

a. Auto mode

In auto mode, the function shall determine switching plans automatically and perform switching operations upon despatcher validation automatically.

b. Manual mode

In manual mode, the function shall determine switching plans automatically and perform switching operations in step-by-step manner. A filter for remote operable & manual switches shall be provided with switching plan.

Reports

Detailed reports of complete switching sequence for VVC operation, including voltage / VAR levels before switching & after switching shall be presented.

Displays

The User interface for VVC function shall have following summary displays as minimum:

a) Network & tabular display to VVC switching
b) Tabular display giving chronological sequence for VVC operation

2.3.10 Load Flow Application (LFA)

The LFA shall utilize information including real-time measurements, manually entered data, estimated data together with the network model supplied by the topology function, to determine the best estimate of the current network state. The Load Flow Application (LFA) shall determine the operating status of the distribution system including buses and nodes The LFA shall take the following into consideration:

a) Real time data
b) Manual entered data
c) Estimated data
d) Power source injections
e) Loops and parallels
f) Unbalanced & balanced loads
g) Manually replaced values
h) Temporary jumpers/ cut/ grounds
i) Electrical connectivity information from the real-time distribution network model
j) Transformer tap settings
k) Generator voltages, real and reactive generations
l) Capacitor/reactor bank ON/OFF status value
m) Save case data

General Characteristics of LF application:

The following general characteristics/ capabilities shall be provided as minimum:

a) The LF model shall support the different kind of lines such as cable feeders, overhead lines and different kind of transformers having various vector groups & winding configurations.
b) Unbalanced & balanced three phase loads connected in radial and non-radial modes.
c) Compute voltages and currents and power factor for each phase for every node, feeder and network devices.
d) Compute each phase active and reactive loads and technical losses for the distribution system, for individual substations and feeder wise with in telemetered zone.
e) Use previous save-case to make new save case or use new snapshots to set the base case for LF.
f) The results of the LF application shall reasonably match with the operating condition in which the distribution system is stable.
g) The LFA function shall be executed in real time & study mode.
h) It shall be possible to model load either as a percentage of system load or profile base load modelling
i) It shall be possible to model individual component of load i.e. Active and Reactive parts

Real Time Load Flow Execution:

The Real-Time LF function shall be executed:

a) on event trigger
b) on periodic basis
c) on demand basis
d) on initiation by other DMS Applications functions
e) On placement of Temporary Jumper, Cuts and Ground

The Event Triggered LF execution shall always have the highest priority. The study mode LF function shall be executed on a snapshot or save case with user defined changes made to these cases. The study mode execution of LF Function shall not affect the Real-time mode execution of LF function.

a) Event Triggered Real Time LF Execution:

The LF function shall be executed by pre-defined events that affect the distribution system. Some of the events the dispatcher may choose for triggers shall include:

- Power system Topology Change I.e. Alteration in distribution system configuration.
- Transformer Tap Position Change / Capacitive/reactor MVAR Change
- Feeder Over loadings
- Sudden change in feeder load beyond a set dead band.

b) Periodic Real Time LF Execution**:**

The real-time distribution system load flow application shall be executed periodically as configured by the dispatcher. The function shall be executed periodically even if there are no significant changes in the operating conditions, as some of the power flow outputs shall be required to provide aggregate summaries (losses, etc.)

c) On Demand Real Time LF Execution**:**

Dispatchers may initiate the real-time LF function at any time through dispatcher command.

d) Real Time LF Execution initiated by other DMS Applications**:**

Other DMS functions may initiate the real-time LF function at any time as desired for the execution of the respective functions.

Study Mode Load Flow Execution:

It shall provide despatchers with estimates of kW, kVArh, kV, Amps, power losses and the other information on the distribution system, but not necessarily reflecting its real-time state. In study mode the application should use the same data model and have direct access of the real-time data as necessary. Study mode load flow shall be used to study contingency cases. It shall be possible to prepare and store at least fifty cases along with the input parameters, network configuration and output results. The dispatcher shall be able to select the saved Case to be used as a Base case for LF execution and modify the base case. Possible changes, which the dispatcher shall be permitted to make, shall include:

a) States of individual power system elements
b) Values of specific parameters including nodal loads, bus voltages, connected kVA, power factor etc.

The Study Mode shall calculate various values for each feeder and prepare summaries as LF output. The Load Flow function shall provide real/active and reactive losses on:

- Station power transformers
- Feeders
- sections
- Distribution circuits including feeder regulators and distribution transformers, as well as the total circuit loss

Load Flow Output:

The following output capability shall be provided:

- Phase voltage magnitudes and angles at each node.
- Phase and neutral currents for each feeder, transformers, section.
- Total three phases and per phase KW and KVAR losses in each feeder, section, transformer, DT substation & for project area Active & reactive power flows in all sections, transformers. List of overloaded feeders, lines, busbars, transformers loads etc including the actual current magnitudes, the overload limits and the feeder name, substation name. List of limit violations of voltage magnitudes, overloading.

- Voltage drops
- Losses as specified above

Display and Reports

All input and output data shall be viewed through tabular displays and overlay on the one-line network diagram. Tabular displays shall consist of voltages, currents (including phase angles), real and reactive powers, real and reactive losses as well as accumulated total and per phase losses for each substation, feeder and project area. All the overloaded lines busbars, transformers, loads and line shall start flashing or highlighted. The LF outputs shall be available in the form of reports. The report formats along with its contents shall be decided during detailed engineering.

Alarms

The LFA shall warn the Despatcher when the current operating limits are exceeded for any element or when lines are de-energized. It shall also warn the Despatcher when any abnormal operating condition exists. Alarms generated during Study Mode shall not be treated as real-time alarms but shall be displayed only at Workstation at which the LF application is running in study mode.

2.3.11 Load Shed Application (LSA)

The load-shed application shall automate and optimize the process of selecting the best combination of switches to be opened and controlling to shed the desired amount of load. Given a total amount of load to be shed, the load shed application shall recommend different possible combinations of switches to be opened, to meet the requirement. The despatcher is presented with various combinations of switching operations, which shall result in a total amount of load shed, which closely resembles the specified total. The despatcher can then choose any of the recommended actions and execute them. The recommendation is based on Basic rules for load shedding & restoration.

In case of failure of supervisory control for few breakers, the total desired load shed/restore will not be met. Under such conditions, the application shall inform the dispatcher the balance amount of load to be shed /restore. The load-shed application shall run again to complete the desired load shed /restore process. The result of any Load Shed operation shall be archived in Information storage and retrieval (IS&R) system.

Basic rules for load shedding & restoration

The load shall be shed or restored based on following basic rules:

a)By load priority

The LSA shall have a priority mechanism that shall allow the user to assign higher priorities for VIP or any other important load. The load assigned with the higher priorities shall be advised to be shed later and restore earlier than load with relatively lower priorities. Each load priority shall be user definable over the scale of at least 1-10.

b)By 24 Hrs. load shed /restore history

The loads of equal priorities shall be advised for restoration in such a way that loads shed first shall be advised to be restored first. The application shall ensure that tripping operations is done in a cyclic manner to avoid the same consumers being affected repeatedly, however, priority loads shall be affected least.

c)By number of consumers affected

The consumer with equal priority and similar past load shed history shall be considered by the application in such a way that minimum number of consumers are affected during the proposed load shed. The data for number of consumers connected to a feeder /device shall be taken from computerized billing system.

Modes of operation

The load-shed application shall operate in the following modes:

a)Manual load sheds
b)Manual load restoration
c)Auto load shed
d)Auto load restoration

Each mode of operation can be enabled or disabled by operator independently. The load can be shed & restore in possible combination i.e. manually shed & auto restore vice versa or both operations in the same modes.

Manual Load Shed

In this mode operator specifies a load to be shed in a project area the software shall determine & propose all the possible combinations of switches to be operated for the requested load shed considering the basic rules for load shed & restoration. In case more than one options are possible, then the application shall identify all such options with the priority of consumers along with the number of consumers are likely to be affected for the load shed option. The despatcher shall select & execute one of these options for affecting the load shed.

Manual Load Restoration

In this mode operator specifies the desired load to be restored. The software shall determine the switches to be operated for the requested load restore considering the basic rules for load shed & restoration.

In case more than one options are possible, then the application shall identify all such options with the priority of consumers along with the number of consumers are likely to be restored for the load restore option if chosen by despatcher. The despatcher shall select & execute one of these options for effecting the load restoration.

The Load Shed Application shall maintain a load restore timer, which shall automatically start after tripping of CB due to manual load shedding. An alarm shall be generated to remind the operator to restore the loads when this timer expires. For manual mode of operation, the dispatcher shall enter the value of load restore timer.

Auto Load Shed

This shall have two modes namely frequency based load shed & time of day based load shed as described below.

a) Frequency based Load Shed

The function shall execute the tripping of breakers based on the system frequency automatically considering the basic rules for load shed & restoration.

The software shall automatically execute the switching operations as soon as system frequency reaches at load shed start (LSS_str) frequency threshold and it shall continue to do so unless system frequency crosses the load shed stop (LSS-stp) frequency limit. The frequency limits shall be despatcher assignable up to single decimal points. This is applicable only for predefined system voltage levels dead band. Once frequency crosses below LSS_stp limit, then load shed can only be started again when frequency attains LSS_str. Limit LSS_str shall be lower than LSS_stp & suitable protection to ensure that shall be provided in user interface such as discard, forbidden etc if user accidently enters LSS _str higher or equal to LSS_stp or LSS are entered higher than LSR.

b) Time of day based Load Shed

The function shall operate to shed load at the predefined time of the day & load to be shed. The software shall automatically execute the switching operations considering the basic rules for load shed & restoration.

Auto Load Restoration

This shall have two modes namely frequency based load restoration & time of day based load restoration as described below:

a) Frequency based restoration

The function shall execute the closing of breakers based on the system frequency automatically considering the basic rules for load shed & restoration. This is applicable only for predefined system voltage levels dead band

The software shall automatically execute the switching operations as soon as system frequency attains load restore start frequency limit (LSR_ str) and it shall continue to do so if system frequency is crosses below the mark load shed restore stop frequency limit (LSR_stp). The frequency limits shall be despatcher assignable up to single decimal points. Once frequency crosses below LSR_stp limit, then load shed can only be started again when frequency attains LSR_str. Limit LSR_str shall be higher than LSR_stp & suitable protection to ensure that shall be provided in user interface such as discard, forbidden etc if user accidently enters LSR _stp higher or equal to LSR_str or LSR limits or LSS _str higher or equal to LSS_stp or LSR limits, lower than LSS. The sequence of frequency limits shall be permitted as LSR str>LSR_stp>LSS _stp >LSS_str. Adequate protection as mentioned above shall be given if user tries to violate the same.

b) Time of day based restoration

The function shall operate to restore load at the predefined time of the day & load to be restored. The software shall automatically execute the switching operations considering the basic rules for load shed & restoration.

Alarms/Events

All Load shed & restore operations executed shall be logged in the system as events. In case the supervisory control fails during the operation in predefined time, an alarm shall be generated with the possible reason for the failure.

Summary Report

Load shed application shall generate Summary Reports for project area on daily basis. These reports shall be available online for minimum period of two days. The following reports shall be made.

Daily Load shed report indicating, substation name, feeder/device name, date/time, duration of load shed and amount of load shed, Number of consumers affected based on consumer indexing information, mode of load shed including planned outages of feeders/network equipment's.

Daily Alarm summary pertaining to LSA, substation wise.

Substation wise daily Served, un-served power & energy for every 5-minute time block

Served & un-served power for last seven days for every 5-minute time block to calculate Load forecast for the next day. The report shall contain a column to define weightage factor (multiplier) by despatcher to calculate Load forecast for the next day. The weightage factor is required to consider the type of the day such as holiday, festivals, rainy day, etc. Separate report for total load forecast of complete project area shall also be generated from above two reports.

2.3.12 Fault Management & System Restoration (FMSR) Application

The Fault Management & System Restoration application software shall aid the dispatcher for detection, localization, isolation and restoration of distribution system after a fault in the system. The FMSR function shall be initiated by any change in the network connectivity due to any fault. It shall generate automatic report on switching sequence depicting analysis of fault, location of fault & recommendations for isolation of faulty sections & restoration of supply.

Functional Requirement

The FMSR function shall include the following characteristics:

a) FMSR shall be capable of handling phase-to-ground and phase-to-phase faults and shall not be restricted by their time of occurrence on one or more feeders. Thus, the ability to handle multiple faults of different types, on multiple feeders, shall be provided. It shall be capable to carry out restoration of large area after an occurrence wide spread faults amounting to substantial outages in the town.
b) FMSR shall can allow the substitution of an auxiliary circuit breaker or line recloser that may temporarily function in place of a circuit breaker or line recloser that is undergoing maintenance.
c) The Operator shall be able to suspend FMSR restoration capabilities by activating a single control point. Otherwise, FMSR shall continue to operate for fault detection and isolation purposes. The Operator shall be able to resume FMSR's normal operation by deactivating the same point.
d) FMSR shall be capable of isolating faulty sections of network by opening any available line Circuit Breaker that may be necessary, however operating limitations on device such as control inhibit flag shall be respected.
e) FMSR application shall utilize the results of LF for recommendations of switching steps for restoration where in it should guide the operator for amount of overloading in lines ,bus voltage violations and amount of load that can be restored for various options of restorations ,the operator shall have the privilege of selecting the best restoration option suggested by FMSR before it starts restoration .The operator shall also be to simulate the LF for the recommended switching actions ,so that the necessary violations can be displayed on graphical display also. If an overload condition is expected because of the proposed switching, it shall be displayed to the operator on a graphical display and proposed alternative switching sequence to avoid or minimize the overload.
f) FMSR shall can use data derived from substation RTUs/FRTUs /FPIs to recognize faults in substation transformer banks, any fault on the primary side of these banks that cause loss of outgoing feeder voltage and current or any fault occurred on 11KV network.
g) FMSR shall be capable to make Restoration plans with identification name and respective merit orders & its execution of Restoration plan using network Display and single line diagram of substation. 8) FMSR shall be capable to find delay in the restoration of network beyond specified time (Dispatcher configurable) and shall be able to report separately in the form of pending restoration actions.

Detection of fault

FMSR function shall detect the faulty condition of the network causing CB tripping due to protection operation or FPI indication. The Circuit breakers having auto-reclose feature, the FMSR application shall wait for programmer specified (settable for individual feeders) duration before declaring the network as faulty. On detection of fault in the network, an alarm shall be generated to draw attention of the dispatcher. Switching device tripping caused by SCADA/DMS applications shall not be considered as a faulty condition. FMSR application shall also not be initiated if the quality flags such as, manually replaced value, out of scan are set for a switching device. To avoid potential difficulties during severe storm conditions, the Operator shall be able to suspend FMSR switching sequence of restoration capabilities by activating a single control point. Otherwise, FMSR shall continue to operate for fault detection and isolation purposes. The Operator shall be able to resume FMSR's normal operation by deactivating the storm-mode control

point. When this occurs, FMSR shall be ready to restore power as well as detect and isolate faults following the next outage event. The same shall be recorded as an event.

Localisation of Fault:

Wherever protection signal or FPI indication is not available, FMSR function shall determine the faulty section by logically analyzing the telemetered data (status of CBs, analog values etc) as acquired through SCADA system. Besides this, for such cases , conventional FLC method method for determining fault shall be used e.g. In case of fault, upstream breaker is tripped & long stretch of multiple sections are having no intermediate fault indicators & intermediate switches are not capable to trip on fault up to the closest NO (Normal open) point, the dispatcher can open the last switch before NO point & instruct the field breakdown team to localize the fault by conventional FLC method. For the sections where protection signal or FPI indication is available, the same shall be derived through these telemetered signals. Network diagram identifying the faulty sections/components shall be displayed identifying the relevant section. and various configurations of switch type etc) Minimum of following switch types shall be considered by FMSR system:

a) Remote controllable circuit breaker with capability to interrupt fault currents
b) Non-remote controllable circuit breaker with capability to interrupt fault currents
c) Remote controllable circuit breaker with no capability to interrupt fault currents
d) Non-remote controllable circuit breaker with no capability to interrupt fault currents.
e) Remote controllable disconnector
f) Non- remote controllable disconnector.
g) Fuse
h) Ground/ Earth switch etc

System isolation & restoration

Once faulty section is identified, the FMSR function shall determine the switching plan to isolate healthy area from unhealthy area. FMSR function shall suggest switching plans for restoration of power to the de-energized healthy sections of the network. It may done be by closing NO switch to allow the power from alternate source. In case more than one feasible switching plans exist, the despatcher shall be guided for most optimum plan based on the merit order i.e minimum switching operations, minimum loss path, system operation within the safe limits of various network elements. The despatcher shall have the option to simulate switching operations and visualize the effect on the distribution network by comparisons based on line loadings, voltage profiles, load restored, system losses, number of affected customers. The FMSR function shall have feature to attain the pre-fault configuration on despatcher's request after repair of faulty sections. The FMSR function shall have following modes of restoration process:

a) Auto mode of restoration
b) Manual mode of restoration

The despatcher shall be able to select one of the above modes. These modes are described below:

a) Auto mode of restoration

In auto mode, the FMSR shall determine switching plans automatically upon experiencing fault & proper isolation of unhealthy network from healthy part of the network and perform restoration actions upon despatcher validation automatically.

b) Manual mode of restoration

In manual mode, the FMSR shall determine switching plans upon experiencing faulty state & proper isolation of unhealthy network from healthy part of the network. The switching plans shall be presented to despatcher for step by step restoration. Despatcher shall be allowed to introduce new steps. A filter for remote operable & manual switches shall be provided with switching plan.

Reports

Detailed reports of complete switching sequence from outage to restoration, feeder-wise outage duration with Date & Time stamp, quantum of served & un-served load, number of consumers interrupted & restored and network parameters limits violations shall be generated by FMSR application

Displays

The User interface for FMSR function shall have following summary displays as minimum:

a) Network & tabular display to identify faulty network
b) Network & tabular display to identify remotely controllable devices
c) Network Display to show plan for Isolation of faulty sections from the network using single line diagram of substation or network as selected by the despatcher.

Tabular display for Restoration plans with identification name and respective merit orders & execution of Restoration plan using network Display, and single line diagram of substation.

Delay in the restoration of network beyond specified time (Despatcher configurable) shall be reported separately in the form of pending restoration actions in Tabular display.

List of sections not restored with the reasons for non-restoration such as overloading and voltage limit violations etc shall be shown in tabular display.

2.3.13 Loss Minimization via Feeder Reconfiguration (LMFR)

This function shall identify the opportunities to minimize technical losses in the distribution system by reconfiguration of feeders in the network for a given load scenario. The technical losses are the losses created by characteristic of equipment's & cable such as efficiency, impedance etc.

The function shall calculate the current losses based on the loading of all elements of the network. The telemetered values, which are not updated due to telemetry failure, shall be considered by LMFR application based on recommendations of LF Application.

Function shall advise the transfer of load to other elements of the network with an aim to minimize the loss. All such advises shall indicate the amount of loss reduction for present load condition. The LMFR application shall consider the planned & unplanned outages, equipment operating limits, tags placed in the SCADA system while recommending the switching operations. The despatcher shall have the option to simulate switching operations and visualize the effect on the distribution network by comparisons based on line loadings, voltage profiles, load restored, system losses, number of affected customers.

LMFR application shall run on demand and whenever there is a violations in network based on State Estimator. Short duration Power Interruption to the consumers during suggested switching operations may be permitted.

Modes of operation

The LMFR function shall have following modes of reconfiguration process:

a) Auto mode
b) Manual mode

The despatcher shall be able to select one of the above modes. These modes are described below:

a) Auto mode

In auto mode, the function shall determine switching plans automatically for minimal loss condition in the network and perform switching operations upon despatcher validation automatically.

b) Manual mode

In manual mode, the function shall determine switching plans automatically for minimal loss condition in the network based on which despatcher can perform switching operations in step-by-step manner. A filter for remote operable & manual switches shall be provided with switching plan,

Displays & Reports

At the defined periodicity or on demand, the despatcher shall be presented with the tabular & graphical displays indicating feeder-wise, substation-wise, project area wide technical losses in % before & after the feeder reconfiguration. The summary report shall also be generated periodically to display technical losses and possible reduction in losses if despatcher follows the LMFR recommended switching operations. The report shall also highlight violations that are occurring in the network with display layers before and after reconfiguration.".

2.3.14 Load Balancing via Feeder Reconfiguration (LBFR)

The Load Balancing via Feeder Reconfiguration function shall optimally balance the segments of the network that are over & under loaded. This function shall help in better utilization of the capacities of distribution facilities such as transformer and feeder ratings.

The Feeder Reconfiguration Function shall be activated either by an overload condition, unequal loadings of the parallel feeders and transformers, periodically or on demand by the despatcher. It shall generate the switching sequence to reconfigure the distribution network for transferring load from some sections to other sections. The LBFR application shall consider the planned & unplanned outages, equipment operating limits, tags placed in the SCADA system while recommending the switching operations. The function shall distribute the total load of the system among the available transformers and the feeders in proportion to their operating capacities, considering the discreteness of the loads, available switching options between the feeder and permissible intermediate overloads during switching. The despatcher shall have the option to simulate switching operations and visualize the effect on the distribution network by comparisons based on line loadings, voltage profiles, load restored, system losses, number of affected customers.

Modes of operation

The function shall have following modes of reconfiguration process:

a) Auto mode
b) Manual mode

The despatcher shall be able to select one of the above modes. These modes are described below:

a) Auto mode

In auto mode, the function shall determine switching plans automatically for load balancing in the network and perform switching operations upon despatcher validation automatically.

b) Manual mode

In manual mode, the function shall determine switching plans automatically for load balancing in the network based on which despatcher can perform switching operations in step-by-step manner. A filter for remote operable & manual switches shall be provided with switching plan,

Displays & Reports

The summary report shall cover the followings:

a) Loadings of feeders and transformers before and after reconfiguration.
b) Voltage profile of the feeders before and after reconfiguration.

The report shall also highlight violations that are occurring in the network with display layers before and after reconfiguration.".

2.3.15 Distribution Load Forecasting

Short-Term Load Forecasting (STLF)

Short-Term Load Forecasting (STLF) analytical function will be used for assessment of the sequence of average electrical loads in equal time intervals, from 1 to 7 days ahead or can be extended for 1 month if required.. As noted above, the STLF function shall be based on different forecasting methods such as:

- Autoregressive.
- Least Squares Method
- Time Series Method.
- Neural Networks.
- Kalman filter
- Weighted Combination of these method

In the first step, training module is executed using load data series from the historical database and weather conditions. After appropriate training, forecast module is executed for up to next 7 days including weather forecast. Results are available in tabular and graphical form. The user shall be able to adjust the active forecast. The adjustments can also be done through weather conditional data parameters i.e. temperature, humidity, precipitation level, wind speed, wind direction acquired through telemetered sensors or manually. STLF will be used for forecasting of loads for the next short-term period (up to 7 days), to provide planning of the (optimal) network operation at the daily level. in periodic time (15 min to 1hr) The user shall be able to save forecasts in save cases, one of which shall contain the active forecast that shall be available for study functions.

Similar day forecasting

A similar day forecast shall be used that is based on the normalized half-hourly load values stored for each of seven-day types. Provision shall be made for storing day types for the last 24 months. The storage shall be updated each day by replacing the oldest of the same day type with the most current actual load curve. The similar day forecast shall search the 24-month file for the same day type whose weather conditions best match. It shall then present the user-entered and best-matched conditions, for user comparison, together with the chosen day's loads as the suggested forecast. The user shall be able to modify any of the forecast's loads manually. In addition, the user shall be able to scale the entire forecast by simply specifying an appropriate peak load value. Multi-day forecasts shall be constructed by permitting the user to define the input data for each forecast day. The results of the previous forecasts will be compared with the actual load realization. The performed differences will be used for updating the forecasting procedure parameters.

Results of Function

a) Main input data for the LF will be:
- Historical Load measurements for specified network points, associated with corresponding weather conditions.
- Daily load curves & energy consumption from the past, for all type of days and seasons.
- Weather prognosis for the forecasting period.

b) Main output data of the STLF will be:
- Forecasted load for the forecasting period

2.3.16 Switching Order Management

A switching sequence (order) shall be a list of operations to be directed by the user when carrying out a pre-defined procedure for switching elements of the distribution network. Switching Order Management power function shall support the manual creation, automatic creation, display, modification, maintenance, and printing of switching orders.

The function shall be designed as multi objective and the user could choose from following criteria:

a) minimum network de-energized time,
b) minimum non-delivered energy,
c) minimum number of switching operations and
d) minimum cost of operations.

Manual Creation of Switching Orders

The DMS functionality shall include an interactive tool to assist the user with the manual creation of switching orders. Manual preparation of the switching order requires as small data entry as possible and ability to start from a previously created order. Each switching order shall include a Header and Content. The Header of the switching order shall contain general information about the switching order (switching order sequential number (ID), User name, start date and time, completion date and time, title of work, description of work, issued by whom and when, acknowledge status).

The Content of the switching order shall include multiple entries defining the switching actions to be taken. The exact form and content of the switching order headers and texts shall be determined by the user during the development of the project. Devices which will be part of the switching shall be added by a drag and drop functionality.

Generation of Switching Orders

The user will be able to initiate the automatic creation of a switching order by using DMS supervisory control procedures. After creating the header as described afore, the user will be able to select either "Manual Creation" or "Automatic Creation". In the automatic creation mode, the user will be able to create the content of a switching order by performing simulated supervisory control procedures on various devices in the order in which they need to be controlled (flags, tagged, opened, closed, etc.).

The ability to define these procedures via the distribution system's schematic and geographical displays shall be supported. No control commands will be generated. Instead, the DMS functionality will enter the identification of the controlled devices and the types of control in the proper sequence required to execute the switching order. Subsequently, the user will be able to review the switching order. This will include manual addition or deletion of entries.

Generation of an inverted switching order

It shall be possible to generate an "inverted" switching order for any previously defined switching order that can be used to restore the circuit to its normal configuration. The DMS functionality shall provide mechanisms to generate inverted switching orders for a specified switching order, and, on demand, to simulate the execution of the inverted switching orders.

Maintenance of Switching Orders

After a switching order has been created, the user shall be able to save it for future use. The DMS functionality shall maintain a general directory of switching orders. This directory shall be organized by area of responsibility selected from of the general directory of switching orders.

The user shall be able to use the directory to review, copy, rename, print, and delete switching orders, and to call them up for review and modification. The user shall be able to select the schematic diagram or the geographical diagram directly from each line in the switching.

It shall be possible to execute previously-defined switching orders in an On-line and in a Simulation mode. Simulation mode execution shall allow the user to check out the switching order's potential impact on the power system, prior to actual execution.

2.3.17 Operation Monitor

The Operations Monitoring function shall track the number of operations made by every breaker, capacitor switch, recloser, OLTC, isolator and load break switch that is monitored by the System. Devices shall be identified by area of responsibility, substation, feeder, and device ID to provide the necessary information for condition-based maintenance of these devices.

Each monitored device shall be associated with a total operations counter. This counter shall be incremented whenever the associated device changes state. When a multiple change (such as a trip- close-trip sequence) is reported by an RTU/FRTU, each transition shall be counted separately. In addition, a fault operations counter is required. This counter shall be incremented only for uncommented trip operations. The date and time of the last operation shall be saved for each device when one of the counters is incremented.

An Operator with proper authorization shall be able to enter a total operations and fault operations limit for each counter. An alarm shall be generated when a counter exceeds its limits. No additional alarms shall be generated if the counter is incremented again before it is reset. For each counter, the System shall calculate the present number of operations expressed as a percent (which may exceed 100%) of the corresponding limit.

The ability to reset individual counters shall be provided. In addition, a user shall be able to inhibit operations counting for individual devices. Such devices shall be included in summaries based on areas of responsibility. Resetting and inhibiting counters shall be permitted only for devices that belong to the areas of responsibility and resetting shall require the console to be assigned to an appropriate mode of authority. The user info, date and time, when each counter was last reset shall be saved. The counters and other related information shall be available for display and inclusion in reports. The user shall be able to view the date and time of a device's last operation together with its accumulated operations data by simply selecting the device on any display where it appears.

2.3.18 Work Order Management

Work Order Management (WOM) shall enable managing switching procedures and all activities related to planned maintenance works, relevant work/safety documents, data storage and requested reports and displays. Management of planned activities followed with appropriate documentation and safety measures is of high priority for every control center.

WOM shall support complete procedure and documents related to planned operations in distribution network which are related to maintenance work and energization of new network elements and equipment after finished construction and commissioning.

2.3.19 Under Load Switching

Under-Load Switching (ULS) power function shall provide simulation of the process of under-load network reconfiguration. Such reconfiguration consists of the change of the supply of a part of a feeder from this one to its adjacent feeder, without breaking the supply of any consumer of both feeders.

Under-load network reconfiguration shall consist of two steps:

- Interconnection of two feeders by switching on a normally open switch; this switching causes a loop consisting of both feeders.
- Disconnection of the loop by switching off another, normally closed switch belonging to these feeders; the latter step must be performed after the first as soon as possible. Values of currents in the interconnected feeders (in the state between two switching operations) will be of main interest in the process of the under-load switching process (the current must be less than threshold for relay tripping).

ULS shall calculate the values of currents in the interconnected feeders, checks these values against time and current settings of appropriate relays and, if necessary, suggests control actions (adjustments of tap changer positions of transformers supplying both feeders, if feasible, for the purpose of minimizing currents at both feeders heads), or provides a list of switching operations needed to perform off-load switching with minimal supply interruption, in the case when the under load switching is not possible.

The main output of the function shall be the list of necessary changes of positions of tap changers of supply transformers, to minimize the currents at both feeders' heads.

2.3.20 Energy Losses

Energy Losses (EL) power function shall provide the simulation of the power/energy losses in the entire distribution radial or weakly meshed network, or its parts, for specified network state and configuration, for the specified time. Total energy losses will be defined as difference between injected and consumed energy. These losses can be divided into technical (copper and iron) and non- technical (theft, bad metering) losses. EL function shall provide simulation of technical power/energy losses by voltage levels, by supply substations, feeders and all network elements, and their participation in total losses. In this a way, this function shall enable identification of most critical parts of the network regarding energy losses.

Having clear insight in losses in the considered network, EL function shall provide basis for reduction of losses and further improvement of network operation. Reduction of losses means not only direct cost reduction, but, implicitly, means better voltage profile and balancing of network element's loads as well.

EL function will be applied for performing different types of analyses:

- Actual network state,
- Saved and forecasted cases,
- Arbitrarily adjusted network state.

Analyses of actual network states shall also include what/if analyses. E.g. these analyses shall provide answer whether some control action would result in losses reduction. All calculations shall be followed by corresponding reports.

2.3.21 Operational Losses

Operational Losses (OL) power function shall provide the overview of realized operational power/energy losses in the entire distribution radial or weakly meshed network, or its parts, for network state and configuration in the selected time in the past. OL function shall provide data about total active/reactive energy injection, active/reactive energy losses, active/reactive energy generation and active/reactive energy consumption in the selected time in the past. In general, energy losses can be divided into technical (copper and iron) and non-technical (theft, bad metering), while OL presents only technical losses.

The function shall provide overview of technical losses by:

- Entire network,
- Supply substations,
- HV/MV transformers,
- Feeders.

The goal of OL function will be to provide:

Identification of total amount of energy injection, generation, consumption and losses realized in operation in the past (this is global indication about network condition),

Identification of losses by network elements (critical network parts according to losses which must be identified and taken into consideration for further operation improvement – losses reduction).

Having clear insight in losses in the considered network, OL function results should provide a basis for reduction of losses and further improvement of network operation. Reduction of losses means not only direct cost reduction, but implicitly means better voltage profile, balancing of loads, as well as better network utilization. All calculations shall be followed by friendly oriented reports.

2.3.22 Reliability Analysis

Reliability Analysis (RA) power function shall be one of the basic DMS power functions. It shall be used for assessment of reliability indices in distribution networks. The function shall deal with "active faults", i.e. faults where the faulted element causes interruption of supply of other – non-faulted elements. It shall point out all critical parts of the network (transformers, sections and buses) from the reliability point of view.

RA function shall assess reliability indices considering any type of remotely controlled and monitored equipment – breakers, switchgear, fault recorders and/or fault pointers, etc.

Besides the classical reliability indices (failure rates, failure duration and availability), the following complex indices shall be derived from these classical ones:

- System Average Interruption Frequency Index – SAIFI.
- System Average Interruption Duration Index – SAIDI.
- Customer Average Interruption Frequency Index – CAIFI.
- Customer Average Interruption Duration Index – CAIDI.
- Energy Not Supplied Index – ENSI.

To calculate the cost of the non-supplied electric energy, which depends on the type and priority of the consumers, the annual value of not supplied energy (ENSI) shall be used as one of the most important reliability index.

The calculation procedure shall be based on failure rates of network elements (sections, transformers, switchgear, bus bars, relays, instrument transformers etc.) and the expected time necessary for restoration of the supply of de-energized parts of the network, after fault of elements has occurred. It shall deal with any type and level of the MV network automation (from networks with no automation to networks with full automation, i.e., with installed fault recorders, fault pointers, remotely monitored and controlled switchgear, etc.).

The main outputs of the function shall be:

- Tabular reports with ENSI, SAIFI, SAIDI indexes for probabilistic calculations, and with CAIFI, CAIDI indexes and lists of interrupted customers for analytical calculations.
- Graphical coloring of network branches and nodes according to reliability indices.

- Ranking list of branches/consumer nodes in accordance with reliability indices.

2.3.23 Optimal Network Reconfiguration

Optimal Network Reconfiguration power function shall be used for determining of the optimal radial distribution network configuration (specification of the normally open switches) from the point of view of the specified criterion (objective function). Following criteria shall be provided:

- Minimal reactive power and energy losses.
- Maximal reliability.
- Best load balance.
- Best voltages profiles.

In addition, this function shall determine the measure of the influence of a switching operation on the performance of the network state. In this way, the function will enable selection of only those switching operation that have the highest influence on the increase of the network state performances.

At the end, the function shall provide the optimal sequence of switching operations for transferring of the network from the considered to the target (optimal) configuration.

The optimization procedure shall be constrained with:

- Feasibility of switching operations.
- Voltage limits.
- Current limits.

The function shall be used in Simulation mode. Function will be used for finding the optimal configuration of the network in the studied case (e.g. the peak-load in the last season, taken from the saved cases).

Main outputs of the function will be:

- The optimal configuration of the distribution network according to the specified optimization criterion,
- The sequence of optimal switching operations for the most efficient transfer of the network from the considered to the target – optimal configuration,
- Benefits provided by the optimal configuration,
- Current/power reserve in the supply transformers and feeders (security),
- Load disbalance on feeder/transformer,
- Voltage deviations,
- Critical voltage,
- Losses reduction.

2.3.24 Network Planning

Network development planning (NDP) shall be used for analysis of the network development in the medium and long-term period.

This function shall perform analysis of Scenarios (the set of new – prospective network configurations), which will be specified in advance. Each element of this Scenario shall be consisted of some specified new elements for network reinforcement. The function should handle both the installation of new and the replacement of old network equipment. The main task for planning function shall be analyzing one or more scenarios and their comparison.

The module of economic mathematics shall provide calculations of investments costs for every Scenario and every new project.

The Summary of every scenario shall be formed by technical reports and economic evaluations, with following information:

a) Amount and changes in losses during the prospective time,
b) The list of problems with overloaded elements or in the other way violated constraints (according to user's criterions),
c) Economic evaluation for every project and the balance of costs for Scenario.

The function shall be completely user-oriented. The interface shall provide very simply both selection of the network part that is of interest and addition of new elements. Also, the interface shall provide fast and simple simulation of all new network configurations, graphical representation of these configurations and corresponding Operation Indices.

The main output of this function shall be user interacted graphical presentation of Scenarios with all DMS analysis and the Report of prospective network configurations, costs and benefits analysis.

2.3.25 Dispatcher Training Simulator (DTS)

A Dispatcher Training Simulator (DTS) shall be provided for SCADA/DMS system for training of operators/ dispatchers during power system normal, emergency/ disturbance and restoration activities. The DTS shall be installed at the SCADA/DMS control center where it shall be used to train employer and other utilities dispatchers. The major DTS features shall include:

a) The DTS model shall simulate the distribution power system in a realistic manner, including its response to simulated events, Instructor actions, and Trainee actions. The response shall be identical to the response observed by the dispatcher in the actual computer system environment.
b) The consoles shall be assignable as trainee or instructor consoles. The DTS shall support at least one instructor & two trainees
c) Instructor control features shall include the ability to set up, control, participate in, and review the results of a training session.

Dispatcher control feature shall facilitate dispatchers to train dispatcher to use all SCADA, dispatcher & DMS functions under normal & disturbed conditions.

An ability to obtain data from the SCADA/DMS systems automatically for DTS initialization. The initialization data shall include save cases, predefined & instructor defined scenarios.

It shall prevent actions & keep insulated the actions performed by the Instructor and Trainee using the DTS from affecting the real-time system database or the actual power system.

An ability to simulate actual system disturbances from historical data "snapshots" stored by the real-Time database Snapshots.

DTS function shall have ability to establish the following training conditions as a minimum:

a) Normal steady state
b) Disturbed network conditions for distribution network
c) High & Poor Voltage conditions
d) Poor VAR conditions
e) Indiscriminate tripping
f) Islanding
g) System blackout
h) System restoration
i) Conditions/functions included for SCADA/DMS real time system Following features as minimum:

- All SCADA/DMS functions as envisaged in the specification
- Cry wolf alarms

- Record/ Playback /slow/Realtime/fast forward
- Record trainee actions

DTS Model features, functions & user interface shall be true replica of SCADA/DMS system model for that project area. The DTS can be used in the following modes as minimum:

a) Instructor Control
b) Trainee Control

a) Instructor Control:

The Instructor shall be able to perform pre-session, session, and post-session activities. Each training session shall consist of executing a scenario (tailored to the simulated SCADA/DMS system) starting from a base case. The base case shall consist of a solved network output case from the NCA or load/power flow and one or more load curves.

Pre-session activities consist of scenario building and development of events that occur during the training scenario. A load/power flow function shall be provided in the DTS to support this feature.

Session activities performed by the Instructor include initiation, control, and participation in the training session.

Post-session activities shall consist of session review and evaluation of Trainee performance. The DTS shall maintain records of the training session so that the base case, scenario, Trainee actions, and other session activities may be reviewed. Instructor shall have all rights of trainee mode also as mentioned below:

b) Trainee control:

All activities, features, functions, user interfaces, which dispatcher can perform or use in real time shall be available to trainee in trainee control mode.

Pre-Session Activities

The Instructor shall be able to create a base case and to execute a power flow if desired to initialize the base case. The Instructor shall be able to build groups of events scheduled to occur during the training session. A training session shall be built by combining one or more event groups with a base case.

Scenario Construction

The following features shall be provided for building a training session:

a) **Base Case Construction:** shall allow Instructor to set conditions, parameters, and limitation for equipment in the network database. It shall be possible to initialize a base case from the following sources:
- A stored base case created in the DTS
- A power flow solution obtained in the DTS
- A power flow or NCA /SE solution obtained from real-time system.
- Output of real time DMS executed functions

b) **Base Case Store**: shall allow instructor to save a base case for future use. It shall be possible to transfer saved base cases to auxiliary memory (e.g., LTO drives) and to reload saved base cases from auxiliary memory.

c) **Base Case Select:** shall allow instructor to select a specific base case for modification or further processing. Base case selection may be indexed by title or subject.

d) **Base Case Review:** shall allow instructor to display the contents of the base case.

e) **Base Case Editing:** shall allow instructor to modify a base case and to store the updated version.
f) **Event Group Construction**: shall allow instructor to construct event groups containing one or multiple events. The Instructor shall be able to define the events within the event group to occur simultaneously or according to other parameters of time or system conditions. Checks shall be performed to assure that each event entered is one of the predefined set of events and that the equipment and parameters associated with the event are valid for the event specified.

The system shall provide an interactive means for specifying the device or point associated with each event.

g) Event Group Store: shall allow the Instructor to save the event group constructed for future use.
h) Event Group Select: shall allow the Instructor to select one or more event groups for incorporation into a training scenario.
i) Event Group Review: shall allow the Instructor to display events within an event group.
j) Event Group Editing: shall allow the Instructor to modify an existing event group and to store the updated version.

Event Types

The Instructor shall be provided with a set of permissible event types that can be scheduled as part of a scenario. As a minimum, the following event types shall be included:

a) Change of bus load
b) Change of system load
c) Fault application/FPI indication
d) Circuit breaker trip/close
e) Circuit breaker trip with successful reclosures
f) Circuit breaker trip with unsuccessful reclosures
g) Isolators switching's
h) Supervisory control disable/enable for specific device
i) Relay status enable/disable
j) Loss of RTU /FRTU due to telemetry failure for specified period
k) Loss of single RTU /FRTU point
l) Replace value of telemetered point
m) Messages to Instructor
n) Pause simulation
o) Demand snapshot.
p) Cry wolf alarms

Event Initiation

Events shall be executed at an Instructor-specified time, when Instructor-specified conditions occur, upon Instructor demand, and when protective relays operate. Event initiation shall include

a) Time Dependent Events: These events shall be scheduled by the Instructor to occur at a specified simulated clock time or at time intervals relative to the start time of the scenario.
b) Conditional Events: Conditional events shall be based on simulated power system conditions obtained from DTS model. The Instructor shall be able to specify a conditional event by specifying a permissible event and a Boolean equation for the power system condition that will trigger the event. The Boolean equation shall allow the following triggers to be incorporated separately or in combination:
    i. A status variable equal to a defined state
    ii. An analog variable above or below a defined threshold
    iii. Change in analog variable from one DTS cycle to the next by more than a defined amount (positive or negative).

c) Demand Events: The Instructor shall be able to demand the immediate execution of an event without having to insert it in the events list.
d) Relay Initiated: The operation of a relay shall result in the execution of one or more Instructor-specified events.

Session Activities

The Instructor shall be able to monitor the training scenario and guide it toward a specific objective by inserting new events omitting scheduled events, and performing other actions. The following commands shall be provided to control a Trainee scenario:

a) Pause/Resume: Shall allow the Instructor to suspend or resume the training scenario without affecting the scenario. While in the Pause mode, the Trainee and Instructor shall be able to call all displays but perform no other functions. The Resume command shall resume the simulation from the point at which the pause occurred.
b) Slow/Fast Forward: shall allow the Instructor to move a training scenario forward at an Instructor-specified speed slower/faster than real-time.
c) Event Insertion: shall allow the Instructor to add new events when a training scenario is in progress without the need to interrupt the training scenario.
d) Event Demand: shall allow the Instructor to demand the immediate execution of an event.
e) Event Omission: shall allow the Instructor to omit a scheduled event from the training scenario in progress without interrupting the training scenario.
f) Periodic Snapshot: shall allow the instructor to create a historical file that is periodically updated with session data necessary to resume simulation as it occurs during the simulation. The DTS shall not pause while the snapshots are being collected and saved. The snapshot save area shall be circular in nature where the oldest snapshot will be overwritten each time a new snapshot is saved when the save area is full.
g) Demand Snapshot: shall allow the Instructor to create a historical file, identical to that created by a periodic snapshot, on demand during the simulation. The DTS shall not pause while the snapshots are being collected and saved.

Post-session Activities

The DTS shall provide the following capabilities to assist the Instructor in reviewing a training session with the Trainee:

a) Snapshot Review: shall initialize the DTS with a snapshot saved during a training session. After a snapshot has been loaded, the Trainee and Instructor shall be able to call displays to examine any data available during a session.
b) Snapshot Resume: shall resume the simulation from a snapshot in the same manner as it would resume from a Pause.
c) Evaluation report: Based on the actions performed, timeliness & An evaluation report shall be created to review performance of trainee.

DTS Performance and Sizing

The DTS shall be sized the same in all respects as the SCADA/DMS control system. In addition, the capabilities of the DTS shall include the following items as minimum:

d) 20 DTS base cases
e) 20 scenarios
f) 250 event groups
g) 50 events per group
h) 50 session snapshots

i) 5-minute snapshot periodicity
j) 100 conditional events
k) 1000 variables in conditional events.
l) 2 Trainee (according to no. of DTS consoles can be added up to maximum of 5) & 1 instructor

DTS Database and Displays

The DTS SCADA and Network model database must have the same functionality & displays as the real-time system database & displays. It must be possible to initialize the DTS with a copy of the database of real-time system in addition creation of database locally.

2.4 Outage Management System

Objective: To improve availability and reliability, consumer satisfaction and enable proactive maintenance to avoid failures.

The OMS applications help operators manage the detection, dispatching, and restoration of network faults which occur unexpectedly on the network as well as the preparation and resolution of outages which are planned for the network.

Outage Management Systems that integrate utility systems such as SCADA DMS and utilize the capabilities of AMR, AMI and grid automation are becoming increasingly important to improve grid reliability through faster location, isolation and rectification or restoration of system faults. Intelligent devices within the network provide real-time information on the status of the network and when combined with meter status information, provide greater visualization of the network up to consumer level.

Outage Management System (OMS) subsystem shall be a set of tools and analytical functions which network operators (dispatchers) will use to manage network outages (incidents and planned outages), including trouble call, fault detection, fault location, isolation and supply restoration, crew management and outage reporting. All operations and comments which occur in this process are documented in data base. The OMS shall be designed to support operators at all stages of the outage life cycle and should be capable of integrating with AMR, AMI, No Light, GIS , DMS and other relevant systems to provide required fucntionalities.

Records of all outages shall be maintained, providing a convenient central repository of distribution outage information that could be used to support historical analysis, the calculation of outage reliability indices, and current real-time operations, such as responding to trouble calls and interacting with field crews. This information shall form the basis for the statistics that can be used for planning the repair work and detecting poor functionality of the Distribution Network elements.

OMS shall provide standard functionality required for resolution of outages, including DMS functions and interfaces to other IT system in DMS.

In case of an outage an appropriate outage record shall be created. After closure of the outage all data shall be stored in a database and available for later outage reports:

- Outage Reports (all outages or per outage type – incidents, scheduled work, load shedding, operations)
- Outage Statistics (SAIFI, SAIDI, CAIDI, CAIFI, Energy not supplied, interrupted customers)

OMS shall include:

- Network model;

- Real-time topological model with tracing functionality;
- Outage tracking functionality;
- Set of DMS applications with near-term response in a scalable high-performance cluster environment
- Historian based on Microsoft SQL Server RDBMS;
- Incident (job) management, providing flexible workflows matching the utilities' business procedures for planned and unplanned work, including safety management/hazards;
- Call management, tracking customer trouble calls and utility customer service representative call backs, integrating with a variety of call sources and using calls to predict the outage cause;
- Customer data management, storing the customer personal data used by call management and directly by the operators, designed specifically for a secure storage of a large amount of sensitive textual data and providing high performance search tools;
- Crew management, tracking the mobile crews and providing workflows around their dispatching, integrating with job/incident management and 3rd party mobile workforce and GPS navigation system in DMS;
- Prediction analysis.

OMS shall be able to run within the real-time services or within dispatcher training simulator, on a student machine, in order to help student to solve potential outages, created by a trainer. That is, the dispatcher training system shall provide the possibility for the utility personnel to be trained in the use of OMS features in the same fashion as it is used in the production environment.

Following permissions shall exist in the OMS:

- Manage customer data,
- View customer data,
- Configure calls,
- Manage calls,
- View calls,
- Configure incidents,
- Manage incidents,
- View incidents,
- Configure crews,
- Manage crews,
- View crews.

The following user roles shall exist within the OMS system:

- OMS User,
- OMS Operator,
- OMS Administrator,
- OMS Customer Service Representative.
- Within the OMS system, following types of outages shall be maintained and they shall be treated

differently:

- Unplanned outages,
- Planned outages,
- Forced outages,
- Load shedding outages.
- OMS shall include different network coloring in accordance with different criteria:

The main components of the Outage Management System (OMS) functionality within DMS shall be:

- Incident Management – The key component of the OMS which shall be responsible for assisting system operators in efficient dispatching of outages, non-outage problems and all other planned works. Incident Management shall be responsible for tracking the information about power disturbances in network and organizing the response to the disturbance into a user-friendly, efficient and safe workflow. The disturbances themselves, together with the information necessary to complete the business processes around them, will be grouped into objects named incidents. The incident shall model all problems in distribution system such as unplanned outage, problem existence, non-outage problems like lights flickering, planned outage and planned work. Incident Management shall be tightly integrated with DMS outage processing and work order management,
- Call Management – Shall be responsible for recording trouble calls and meter AMI last gasp event data. It will keep the real-time image of the currently active calls, AMI events, and callbacks; manages the configuration of valid values for call and callback types, reasons and results; and archives the closed calls to the historical database. The Call Management component shall keep and processes a large number of trouble calls in order to support high activity scenarios, without affecting the system performance of the DMS environment. Processing of trouble calls is shall be realized with optimal processing where every single trouble call is not individually processed, in order to avoid system loading with unnecessary actions,
- Customer Data Management – Customer data shall be the main set of input data to any OMS, since it presents the main information for connection to trouble call and identification of affected part of network. In DMS-OMS environment customer data shall be stored in the Customer database. This data will be initially migrated from CIS and after initial migration only incrementally updated via appropriate interface. Customer database shall contain private customer data (non-electrical) from CIS. Electrical data of the network shall be stored in unique network model instance of the system. In order to visualize customers' information and customers' trouble calls, every customer in customer database will have a SDP (Service Delivery Point) identification which presents connection between non-electrical customer data and electrical data of the network. Service delivery point shall present the object of the network model,
- Crew Management – This component shall perform all actions related to crews required by OMS user. Crew Management will store information necessary to track crews, contact them and assign them to work. Crew Management shall be responsible for tracking the information about crew locations, crew availability, crew members, crew vehicles, and efficient assistance to the user for optimal assignment of crews to planned or unplanned work in the network.

Creating and assigning profiles for OMS shall be available.

2.4.1 Incident management

List of all active incidents shall be available to the user.

List of all closed incidents in previous period retrieved from historical database shall be available in the system.

In **Incident Overview**, data regarding incidents in the entire network shall be available. For supervisors and shift managers in the control room, or even managers accessing from the corporate environment, **Incident Overview** will offer a dashboard type of view into the OMS aspects of the current state of the distribution system.

It shall be possible to color part of the network affected by incident by different criteria:

- Incident confirmation,
- Problem existence,
- Incident type,
- Incident subtype,
- Outage time range,
- Incident status,
- Incident priority,
- Nested incident.

Prediction results shall be presented as the upstream protection device which shall be a candidate for the outage cause, as well as the network part affected by that device containing a full list of customers. Further candidate devices shall be also stored and used in case of merging the incidents based on the incoming calls.

2.4.2 Call management

List of all active customer calls in the system containing the information important for identifying the problem shall be available. When new call is created or removed, the list of calls shall be updated automatically.

Call Management shall be responsible for book–keeping of any customer call related data. It shall keep the real–time image of the currently active calls and callbacks, manage the configuration of valid values for call and callback types, reasons and results, and archives the closed calls to the historical database.

List of all callbacks created in OMS will be available in the system.

OMS shall process AMI last gasp events created and published from smart meters, and shall act upon the new AMI last gasp events in the configured way (known as stewing), by starting a workflow which may consist of creating a new incident or triggering prediction. It shall also interface with the AMR system of NEA as well as No Light. The successful bidder shall study in detail the functionalities of current system and incorporate the same in OMS.

2.4.3 Crew management

List of all crews shall be available in the system. Crew management shall store all information necessary to track crews, contact them and assign them to work. Crew management shall be responsible for tracking the information about crew locations, crew availability, crew members, crew vehicles, and efficient assistance to the user for optimal assignment of crews to planned or unplanned work in the network.

Representation of each crew member in shall be associated with his domain account; therefore field client shall be able to automatically filter each crew member's data, after his authentication.

List of all crew members shall be available in the system, as well as a possibility to create a new crew member and define skills that he has.

List of all crews shall be presented. Dispatcher shall have quality indicator displayed together with the GPS coordinates, in order to have clear information that the vehicle is not in GPS coverage, GPS device is broken, AVL service is down, integration adapter is down etc., and see the symbol as stale.

2.4.4 Customer data management

Complete information about all customers fed from any given point in the network shall be available in the system as well as a list of all customers with data about interruptions in the previous period.

Customer data shall be restricted to the users with special permissions to access it (normally permissions are managed by authorized utility personnel). Typically these permissions shall be given to call center users, as well as some (though not necessarily all) of the operators.

The information stored as part of the customer data management shall include, but shall not be limited to:

- account ID,
- account type,
- additional reference IDs (may include A M R / AMI meter ID, or IDs into other external system in DMS), name (first name in case of persons, company name in case of businesses) and last name (where applicable),
- additional contact name (sometimes applicable for businesses),
- address (street address, postal code, city, additional location information),
- Contact information (multiple phone numbers, mobile number, fax, email etc.),
- contract details and
- Connection status (non–payment, etc.).

The Customer Historical Browser shall contain a list of all customers with data about interruptions in the previous period. The browser shall list affected customers with appropriate statistic about incidents where those customers were included.

2.4.5 Alarms

Alarms generated by SCADA shall be classic limit violations, rate of change, uncommanded status change and alarms related to system health.

Each alarm shall represent a single abnormal condition. Alarms shall be presented with descriptive message, which shall be also intuitive and easily interpreted.

Complete list of alarms shall be available in the system and shall be accessible through the alarm summary. Alarm summary shall be an ordered list in which alarms shall be sorted first by priority and then chronologically. The newest, highest priority alarms shall be at the head of the list, which includes the alarm date, time, mnemonic code, point description and logging text. All alarm summary displays are filtered by the user's area or responsibility and may be further filtered by alarm category and the disturbance mode threshold. Alarm summary displays are dynamic; the number of display pages varies from one up to as many as required to hold all of the entries.

Available **Alarms Summaries** shall be:

- **Alarm Summary**, which shall display complete list of alarms,
- **Alarm Limits Summary**, which shall show all alarm limits in RTDB,
- **Acknowledged Alarm Summary**, which shall display a list of all acknowledged alarms in the system,
- **Alarm Overrides Summary**, which shall contain a list of all alarm limit overrides in RTDB,
- **Alarm Limits Set Summary**, which shall show all alarm limits set in RTDB,
- **Alarm Notification User Summary**, which shall show the list of all configured alarm notification users with their configured information,
- **Alarm Notification User Group Summary**, which shall show the list of all configured alarm notification user groups with their configured information,

Device Alarm Summary, which shall list the alarms related to the selected device

2.5 Remote Terminal Unit (RTU)

2.5.1 General Overview

The Remote Terminal Unit (RTU), shall be installed at Substations & Power stations to acquire analog data, device status and events. RTU shall also be used for control of station devices from Master station. The supplied RTUs shall be interfaced with the Control & Relay (C&R) panels, Transducers, IEDs, Metering Equipment, Communication equipment, Power supply distribution boards; for which all the interface cables shall be supplied by the Contractor.

This document describes the specifications for the Remote Terminal Unit (RTU). Contractor shall supply RTU, associated equipment such as transducers, relays, weather sensors, modems, cabling etc. and required number of panels for housing of all the hardware envisaged for the RTU.

The contractor shall be responsible for supplying all hardware, software, installation, cabling and field implementation for RTU as defined in this Specification. The contractor shall also be responsible for integration of supplied RTUs with the existing SCADA/EMS System of the owner as per the specified protocols and interoperability profile. Necessary additions/modifications in SCADA System databases and displays for integration of RTU with SCADA/EMS System shall be in the owner's scope. The contractor shall also provide complete documentation, training and testing to fully support the hardware and software provided. The RTU shall be used for real-time supervision and control of substation/ power plant through SCADA system. RTU configuration/ point count, MFT/MFM count, modems**.**

Should the Contractor elect to subcontract manufacturing, installation, testing & commissioning or any work defined herein, it shall remain the Contractor's responsibility to complete the assigned work.

It is Owner's intent that the Contractor uses as much standard hardware and software as possible; cabling should be minimized; system design should be as much modular as possible and CMRs should be used only when essential. However, the system supplied by the vendor should satisfy all the functional require-ments of this Specification. The Contractor shall supply all the necessary items and provide a complete RTU design that meets all the Owner's functional requirements defined in this Specification.

In event of the configuration of RTU given in specification undergo changes during detailed engineering, the prices of RTU shall also be adjusted based on the unit prices of Transducers, Meters, status Input cards, analog input cards, control output cards, control output relays, CMRs and Modems etc.

Owner may not initially procure all capabilities specified in this document. Regardless of the RTU configuration purchased, the RTUs shall be capable of all functions specified herein with the addition of the necessary hardware and software modules in the field when required by Owner. Each function is presented in sufficient detail to provide the Contractor with as much insight as possible into both the initial and future requirements of the RTUs.

2.5.2 Design Standards

The RTUs shall be designed in accordance with applicable International Electro-Technical Commission (IEC), Institute of Electrical and Electronics Engineer (IEEE), American National Standards Institute (ANSI), and National Equipment Manufacturers association (NEMA) standards, unless otherwise specified in this Technical specification. In all cases the provisions of the latest edition or revision of the applicable standards in effect shall apply.

2.5.3 RTU Functions

All functional capability described herein shall be provided by the Contractor even if a function is not initially implemented. The term master station is used to denote the SCADA systems. As a minimum, the RTUs shall can perform the following functions:

a) Collecting and processing the digital status inputs, analogy inputs, event records, accumulated values and transmitting to master station(s).
b) Receiving and processing digital & analogy control commands from the master station(s).
c) Accepting polling messages from at least four master station(s) simultaneously using separate logical databases for each master station.
d) Communication simultaneously on all Communication ports and using multiple concurrent protocols including IEC 60870-5-101, 60870-5-104, IEC 61850, MODBUS (Serial & TCP/IP).
e) Data transmission rates from 300 to 9600 baud for serial ports (for both IEC 60870-5-101 & MODBUS) and 10/100 MPs for TCP/IP Ethernet ports.
f) RTU shall be compatible with protocol 61850 for communication with IEDs.
g) RTU shall have the capability of automatic start-up and initialisation following restoration of power after an outage without need of manual intervention. All restarts shall be reported to the connected master station(s).
h) RTU shall have dual redundant CPU and Power Supply unit.
i) RTU shall support time synchronization through messages received from master station using IEC 60870-5-101 protocol.
j) RTU shall support SOE (Sequence of events) feature.
k) Acting as a data concentrator for acquiring data from Slave RTUs, MFMs /MFTs and exercising supervisory control on slave RTUs, MFMs/MFTs using IEC 60870-5-101, IEC 60870-5-104 and MODBUS.
l) Harsh environmental coating.

2.5.4 Communication ports

The RTUs shall support simultaneous communications with multiple independent master stations (SCADA system), maintenance and configuration terminal (Laptop PC), a local logger (printer), Multi-function transducers and Local Data Monitoring System (LDMS)/Logger.

The RTUs shall have the following minimum number of communication ports:

a) Two Ethernet ports for connectivity to Master Station on IEC 60870-5-104.

b) Required number of Ethernet ports (minimum two) for communication with IEDs on IEC 61850, Energy Meters on MODBUS TCP/IP, etc.

c) Minimum 2 Nos Serial ports for communication on IEC 60870-5-101 in dual standby mode (with single master) or active/active mode (with dual master).

d) Port(s) required for Cellular Data Communication.

e) One port for the RTU maintenance and configuration terminal.

f) One port for Local Data Monitoring System (LDMS)

g) Required number (minimum two) RS485 ports and/or TCPIP ports for polling Multi-Function Meters, Multi-function Transducers using MODBUS, IEC 60870-5-101 protocol in multi-drop (party line) mode or IEC 60870-5-104 protocol. In multi-drop mode maximum 8 No MFTs/MFMs shall be connected to a single port.

h) SSL/VPN ,NERC/CIP complaint

It shall be possible to increase the number of communication ports in the RTU by addition of cards, if required in future. The RTU shall respond to independent scans and commands from Master Station, LDMS and Configuration & Maintenance Terminal simultaneously. The RTU shall support the use of a different communication data exchange rate (bits per second) and scanning cycle on each port. The RTU shall be capable of being configured into point to point and party-line communication mode.

2.5.5 CPU and Power Supply

The RTU shall have redundant CPU and Power Supply unit so that the RTU can communicate with the Master Stations even when one of the redundant units fails. A failover process shall cause the assignment of all the functions of the failed unit to the healthy unit. The failover between the two redundant units shall not require any manual intervention and shall not cause any interruption in the functioning of RTU. The failover process of the CPU shall not take more than 30 seconds after the failure of primary CPU. All the functions of RTU shall be operational within 30 seconds of the failover operation i.e, within one minute from the time of failure of primary CPU.

2.5.6 Local Configuration & Maintenance Interface

The RTUs shall include the interface to support the portable configuration and maintenance terminal (PCMT). The interface shall provide easy access to allow owner to use the maintenance terminal at the RTUs installed in the field.

2.5.7 Local Data Monitoring System (LDMS) Interface

The LDMS shall be used for local data acquisition, monitoring and control of substation parameters through RTU. The LDMS shall be a mini SCADA system providing MMI capability for use in the sub-station control room building. The LDMS software shall include following functions:

a)data acquisition for analogy, digital, events and pulse accumulator type data

b)data processing – Conversion to engineering units, limit monitoring, data validity test, calculated data

c)Calculated data (such as maximum, minimum, average values with associated time-stamping etc.) of all the station parameters.

d)Sequence of Events Processing

e)Supervisory control

f) Alarm, tagging, trending, quality codes etc.

g)Single Line Diagrams, Trends, daily, weekly, monthly reports etc. shall be prepared by the bidder and integrated on LDMS system. The LDMS shall also have capability to generate additional displays, single line diagrams, reports and trends.

The LDMS shall store all real-time telemetered & calculated data after every 1 minutes (adjustable to 5, 15,30,45,60 minutes). The software and hardware shall be sized for storage of all the above data after every 1 minutes for at least one-year duration. All alarms, events, SOE etc. shall also be stored on regular basis. It shall be possible to define daily, weekly, monthly Sub-Station reports on LDMS. It shall be possible to generate reports highlighting the maximum, minimum, average with associated time-stamping etc. of all the

station parameters. The historical data stored on the storage medium shall be in standard format and necessary tools for its export to standard spreadsheet programs (Excel and .csv) shall be provided.

The LDMS shall update analog data from RTU by exception or cyclically after every five to sixty seconds (programmable) and status data by exception. The SOE status data shall be recoded with resolution of 1 mis timestamp.

The contractor shall supply separate license for each copy of LDMS software.

2.5.8 Communication between RTU & MFT/MFM

The MFT/MFMs will act as slave to the RTU. The RTU shall communicate with MFT/MFMs to acquire real time analog data, digital data, and time stamped events and execute control commands issued by the master station. The RTU shall acquire analog data from MFT/MFMs cyclically and digital data by exception. All data from the devices connected on a single port shall be acquired within 5 seconds. The RTU shall have the ability of issuing retry scan to acquire data from the MFT/MFMs in case of communication failure between RTU and MFT/MFMs.

2.5.9 Master Station Communication Protocol

The Contractor shall provide a communication protocol for communicating with SCADA master stations using the IEC 60870-5-101 and IEC 60870-5-104 communication protocol standard. The communication protocol shall support all the requirements of this standard. The communication protocol shall be non-proprietary and the Contractor shall provide complete description and documentation of the protocol to Owner.

The RTU shall perform as a slave to SCADA master station when using the IEC 60870-5-101 protocol. All communication shall be initiated by the SCADA master stations. RTU must notify the master stations of unusual conditions at the RTU (such as a power fail/restoration or RTU malfunction), the transfer of changed data etc. All the notifications shall be accomplished within the framework of the periodic data acquisition exchanges.

The RTU shall store the data acquired from the MFT/MFMs & IEDs in its database and do processing like change detection/dead band processing on the data for optimizing its transmission to the Master Station (SCADA Control Centre). The processing shall include requirements of mapping of information from the protocol of MFT/MFM/IEDs to the protocol requirement for communication with Control Center.

The RTU shall process the various messages/commands for communication to the Master station using the following priority.

a) Control command

b) Status data by exception

c) Analog data by exception

d) Analog data periodic

e) Status data integrity scan

The communication interface to the master station(s) shall allow scanning and control of defined points within the RTU independently for each master station using a separate logical database in the RTU. It shall be possible to pick points from the RTU database randomly and assign it for reporting to a Master station. Further, the RTU shall support the use of a different communication data exchange rate (bits per second), scanning cycle, and/or communication protocol to each master station.

Scan groups

Analog and digital input points (including points reported by exception) shall be assignable to scan groups. A scan group shall be a specified set of data points within the RTU central database which will be communicated to a master station when requested by a specific (addressed) scan request. A scan group size shall only be limited by the communication protocol message length. Any RTU input point shall be assignable to any scan group. The RTUs shall support at least sixteen scan groups and all scan groups per communication port (i.e. master station/ LDMS interface). The Contractor shall provide a convenient and flexible scheme for assigning points in the RTU to scan groups.

Reporting of status points

The RTU communication protocol shall be configured to report digital status changes by exception to master station. Digital status data shall have higher priority than the Analog data. All the digital status data shall also be assigned to scan groups for integrity check by Master stations at every 10 minutes.

Reporting of Analog points

The analog data shall be reported periodically to update all the values at the master station within 10 seconds (configurable from 5 to 20 seconds). Analog data shall also be reported by exception if the analog value exceeds its previous value by more than 20% (configurable from 1% to 20% in the RTU).

Digital control commands

The RTU shall follow the select-and-execute sequence for operation of digital control commands from the master station. The RTU shall reset its control logic upon any error in the sequence.

2.5.10 Analog Inputs

The RTU shall accommodate analog inputs which are unipolar or bipolar, 2-wire ungrounded differential signals. All analog inputs are of +4 to +20 mA. However, the RTU shall can accept other standard analog input ranges (0 to 5V, 0 to 10V, 0 to 10mA, -10 to +10 mA).

The RTU shall make all appropriate signal level conversion and conditioning to allow full utilization of analog inputs and meaningful reasonability checking. The analog-to-digital converter shall have a minimum resolution of 32767 counts (sign plus 15 data bits). Each type of analog input shall be converted with full resolution. The RTU shall monitor the drift in characteristics of its ADC and mark the analog points with a drift quality code if a drift is detected. This drift quality code shall be sent to the master station also.

The RTU accuracy, for analog input measurement, shall be 99.8% or better at 25-degree C ambient temperature. Mean accuracy shall drift no more than 0.002% per degree C within the temperature range of –5 to +55-degree C. Determination of accuracy shall be made while the analog multiplexer is operating at rated speed.

Each input shall have suitable protection and filtering to provide protection against voltage spikes and residual current at 50 Hz, 0.1 ma (peak-to-peak) and overload. Loading up to 150% of the input value shall not sustain any failures to the RTU input. The total input impedance offered by the RTU shall not be greater than 250Ω (for +4 to +20 mA range).

All analog inputs shall be scanned by the RTU from the field at least at 1 second periodicity.

2.5.11 Status Inputs

RTU shall can accept isolated Dry Contacts, internally wetted @ 48VDC or Wet contact @ 220VDC or 110VDC (±30%) for status inputs. All status inputs shall be wired by the contractor to MFT/MFM or RTU through 220VDC or 110VDC or 48VDC (±30%) Wet Contact wired directly from semaphores in the C&R

panels. In case the contacts are wired to MFT/MFM, the status input data shall be reported to RTU with time stamp using IEC – 101/104. It is the owner's intent to minimize the use of Contact Multiplying Relays (CMRs), to minimize the number of components and its associated failures. The contactor shall use CMR to convert wet contact to isolated dry contact only when it is necessary for satisfactory performance of the system.

For dry contacts, the RTU shall provide necessary sensing voltage, current, optical isolation and de-bounce filtering independently for each status input. The sensing voltage shall not exceed 48 V DC. The sensing voltage source shall be isolated from that of the RTUs logic power so that any noise or a short circuit across the sensing supply of a digital status input terminals would not disrupt the RTU operation other than the shorted digital status input.

The RTU shall be set to capture contact operations of 20 ms or more duration. Operations of less than 20 ms duration shall be considered no change (contact bounce condition). The RTU shall accept two types of status inputs i.e. Single point Status inputs and Double point status inputs.

Single point status input will be from a normally-open (NO) or normally-closed (NC) contact which is represented by 1-bit in the protocol message.

Double point status input will be from two complementary contacts (one NO and one NC) which is represented by 2-bits in the protocol message. A switching device status is valid only when one contact is closed and the other contact is open. Invalid states shall be reported when both contacts are open or both contacts are closed.

All status inputs shall be scanned by the RTU from the field at 1 millisecond periodicity. The RTU shall store all status changes detected for retrieval by the master stations. For communication delays or short-term failure of communications with a master station, the RTU shall store a minimum of 300 status change events. The RTU shall report any overflow of this status change buffer to the master stations.

Contact Multiplying Relay

Contact multiplying relays (CMRs) may be required to multiply the auxiliary contacts of breaker/isolators etc. The contacts of these relays shall be used to provide status input to the RTUs. The relays shall be of self-reset type. The relay shall have a minimum of two changeover contacts each with minimum current carrying capacity of 5 A at 48 V DC.

The relays shall conform to the following requirements:

a) Power frequency with stand voltage: 2 kV for 1 minute as per IEC standards.
b) Insulation resistance of 100 M ohms at 500 V DC.
c) 5 KV Impulse test as per IEC standards

The CMRs shall have a LED indication which shall light up when the CMR is energized (picked up) condition. The CMR coil shall be rated for the voltage existing at the site. The CMRs shall be generally mounted in existing control & Relay panel but in case of non-availability of space, it shall be accommodated in the System Interface Cabinets (being supplied by the Contractor).

Momentary Change Detection

Two-state status input points with momentary change detection shall be used by Owner for points where multiple operations (changes of state) can occur between scans from the master station (such as breakers with auto-reclosing devices that operate faster than the master station scan rate). The RTU shall capture and maintain all the momentary changes, up to 4 per MCD digital status point. The MCD status input points shall be set to capture operations of greater than 20 ms duration.

Alternatively, the RTU can store and report the multiple state changes of a digital input as discrete events. It shall be ensured that all the changes are reported to the Master station in the sequence in which they occur in the RTU.

2.5.12 Sequence of Events (SOE) feature

SOE is the time-stamped digital status data. SOEs will enable Owner's personnel to determine the sequential operation of digital status input devices for their state changes. The RTU shall time-stamp the digital status data with a time resolution of one millisecond.

Initially, all breakers, protection contacts digital status input points in the RTU & events captured from IEDs shall be configured as SOE points. However, it shall be possible to assign any digital status input data point in the RTU as SOE point.

Each time a SOE status input point changes state, the RTU shall time-tag the change and send it to the Master station. The RTU shall maintain a SOE buffer within the RTU for communication delays and communication failure. SOE buffer shall be sized to store, as a minimum, of 5000 events. The RTU shall transmit the SOE data stored in its buffer to master station. An acknowledgement of receipt by the master station shall be made prior to the loss of any data in the RTU SOE buffer. Data not received at the master station shall be retransmitted. The RTU shall send a message to the master station to indicate the RTU SOE data buffer overflow condition.

2.5.13 Control Outputs

The RTU shall provide the capability for a master station to select and change the state of digital output points either directly or through MFT/MFM. In case the Control Output is provided through MFT/MFM, the communication between RTU & MFT/MFM shall also support select before operate functionality. Device control will be used by owner to control power system devices including:

(a) Two-state Devices: Circuit breakers, motor-operated switches, auto/manual switches, relay disable/enable, and other two-state devices

(b) Variable Output Devices: Raise/lower control of generators, transformer load-tap-changers (LTC), and other variable output devices.

The RTUs shall have the capability for control outputs as described in the following sections

Two State Momentary Control

A pair of outputs shall be supplied for each two-state (open/close) control output point that drive control relays. One output shall be supplied for open, the other for close. Upon command from a master station using the check-before-execute sequence, the appropriate control output shall be operated for a preset (momentary) time. The operation period shall be adjustable for each point from 0.1 to 2 seconds.

Raise/Lower Pulse Output

A pair of outputs shall be supplied for each (raise/lower) control output point that drive control relays. One output shall be supplied for raise, the other for lower. When commanded from the master station, the appropriate raise or lower output shall be operated for the selected time interval. The closure time interval for raise/lower pulse output points shall be specified in the operate command from the master station. The raise/lower output for each point shall operate over a range of 0.1 to 4 seconds in a minimum of eight equal increments.

Timed Supervisory Control

The RTU shall store Timed Supervisory control command received from the SCADA system. This supervisory control command from the SCADA system shall contain the 'time' up to a resolution of milliseconds and the type of control Operation.

The RTU shall then perform the supervisory control command at the specified time. The SCADA system shall be able to cancel this command prior to the occurrence of the specified Time of Operation.

Control Output Interposing Relays (Double Contact Digital Output)

Control output interposing relays shall be supplied by the Contractor for each control output specified in Appendix - A. Each control relay shall consist of two isolated single-pole doubles-throw contacts. The output contacts shall be rated to carry minimum current of 10 amps at 220 V DC, and shall provide arc suppression to permit interruptions of an inductive load. Relay coils shall be shunted with diodes to suppress inductive transients associated with energizing and de-energizing of the relay coils. The relays shall conform to the IEC standards.

Latching (Dummy Breaker) Relay

The Contractor shall provide a latching relay to be used to simulate and test supervisory control from the RTU. The simulation relay shall accept the control signals to open and close from the RTU, and shall provide the correct indication response through a single contact indication input point. This point is not included in the RTU point count in **Appendix - A.**

Control Security and Safety Requirements

The RTU shall include the following security and safety features as a minimum for control outputs:

a) Select-and-execute sequence for control output.
b) No more than one control point shall be selected at any given time.
c) The control selection shall be automatically cancelled if after receiving the "control selection" message, the "control execute" command is not received within the set time.
d) The control selection shall be automatically cancelled if after receiving the "control selection" message, the "operate" command is not the next received message and is not received within the set time.
e) No control command shall be generated during power up or power down of RTU.

Local/Remote selector switch

A manual Local/Remote selector switch shall be provided for each RTU to disable all control outputs by breaking the power supply connection to the control outputs. When in the "Local" position, the Local/Remote switch shall allow testing of all the control outputs of RTU without activating the control outputs to field devices. A status input indication shall be provided for the Local/Remote switch to allow the SCADA system to monitor the position of the switch. This point is not included in the RTU point count defined in Appendix - A.

2.5.14 Time facility

The RTU shall have an internal clock with the stability as defined. The RTU shall be synchronized through synchronization message from master station at every 10 minutes using IEC 60870-5-101 protocol. The RTU shall support the calculation of the propagation delay dynamically by the Master station. However, all the RTUs shall have a suitable interface for receiving synchronization signals from a local GPS receiver.

The RTUs communicating over IEC-60870-5-104 shall be supplied with a GPS receiver for synchronization of RTU clock.

The RTU shall synchronize its internal clock with the master station system clock when time synchronization messages are available and shall mark all the time stamped information/data as invalid when the RTU clock is not synchronized with the Master station.

2.5.15 Diagnostic features

The RTU design shall facilitate isolation and correction of all failures. The following features which promote rapid problem isolation and replacement of failed components shall be provided:

a) Self-diagnostic capabilities within each RTU which can be initiated at the RTU site. The diagnostic software shall check for memory, processor, and input/output ports errors and failures of other functional areas defined in the specification of the RTU.

b) On-line error detection capabilities within the RTU and detailed reporting to the connected master station of detected errors. It shall be possible to choose the errors to be sent to the Master station within the framework of the communication protocol.

c) Local indication of major RTU failures

d) A non-volatile event buffer that shall record all fatal errors/restarts/ faults.

2.5.16 Input DC Power Supply

The RTU will be powered from a 48 V DC (+ve earthed) system. The RTU shall not place additional ground on the input power source. The characteristics of the input DC power supply shall be

(a) Nominal voltage of 48 V DC with operation between 41 and 60 V DC.

(b) Maximum AC component of frequency equal to or greater than 100 Hz and 0.012 times the rated voltage peak-to-peak.

The RTU shall have adequate protection against reversed polarity, over current and under voltage conditions, to prevent the RTU internal logic from being damaged and becoming unstable causing maloperation.

2.5.17 Environmental Requirements

The RTU will be installed in control room buildings with no temperature or humidity control. The RTUs shall be capable of operating in ambient temperature from -5 to +55-degree C with rate of temperature change of 20-degree C/hour and relative humidity less than 95%, non-condensing. At some locations, environmental temperature may go below –5-degree C for which the contractor shall take suitable measures for successful operation of RTU.

2.5.18 Noise level

The audible noise generated by the RTU equipment shall not exceed 50 dbas one meter from the enclosure.

2.5.19 RTU Size and Expandability

The software and the database shall be sized to accommodate growth within the ultimate sizing parameters as defined in this specification for the RTU without requiring software or database structure regeneration.

The point counts for the RTUs have been defined in the **BOQ.** The RTU shall have additional wired available reserve capacity of twenty percent (20%) for each type of points defined in the BOQ. This reserve capacity shall be used without any additional hardware such as I/O cards and terminal blocks.

The RTUs delivered shall have the capability to accommodate additional I/O modules to expand the overall point count of the RTU by a minimum of fifty percent (50%) i.e. 80% more than the actual RTU count defined in the BOQ. The I/O modules here means Status Input module, Analog input module and the Control output

module. Other modules, such as processor module, racks etc. as required to meet the overall expandability requirement defined above shall also be supplied by the contractor.

2.5.20 RTU Panel

The Contractor shall provide RTU Panels along with complete accessories. Generally, MFTs/MFMs will be housed in the C&R panels and the owner may at his discretion prefer to install the interposing control relays & interface terminal blocks etc., in the RTU panel. The panels shall meet the following requirements:

a) Shall be free-standing, floor mounted and height shall not exceed 2100 mm.
b) Shall have maintenance access to the hardware and wiring through lockable full height doors.
c) Shall have the provisions for bottom cable entry
d) The safety ground shall be isolated from the signal ground and shall be connected to the ground network. Safety ground shall be a copper bus bar. The contractor shall connect the panel's safety ground of to the Owner's grounding network. Signal ground shall be connected to the communication equipment signal ground.
e) All panels shall be supplied with 230 Vac, 50 Hz, single-phase switch and 15/5A duplex socket arrangement for maintenance.
f) All panels shall be provided with an internal maintenance lamp, space heaters and gaskets.
g) All panels shall be indoor, dust-proof with rodent protection, and meet IP41 class of protection.
h) There shall be no sharp corners or edges. All edges shall be rounded to prevent injury.
i) Document Holder shall be provided inside the cabinet to keep test report, drawing, maintenance register etc.
j) All materials used in the enclosures including cable insulation or sheathing, wire troughs, terminal blocks, and enclosure trim shall be made of flame retardant material and shall not produce toxic gasses under fire conditions.
k) The structural frame of the panels shall be of cold rolled sheet steel of thickness not less than 3 mm for the weight bearing members of the panels such as base frame, front sheet & door frames and 2mm for sides, door, top and bottom portions.
l) All sheet steel work shall be degreased, pickled, phosphated in accordance with IS6005. The phosphate coating shall be sealed with application of two coats of ready mixed, staving type zinc chromate primer. Two coats of synthetic enamel paint (RAL7032 shade) shall be applied both in the exterior and the interior of the panel.

2.5.21 Interconnections

All cabling between component units of the RTU, RTU to interface cabinet, RTU to MFTs/MFMs and to the Owner control and relay panels (located in the substation control room) shall be supplied and installed by the Contractor and shall be shown on Contractor supplied drawings. Plug-type connectors with captive fasteners or compression type connectors shall be used for all internal interconnections. The connectors shall be polarized to prevent improper assembly. Each end of interconnection cables shall be identified by a marker which includes the cable number and the identifying number and location of each of the cable's terminations. This information shall match with the Contractor's drawings.

Adequate space and hardware shall be provided for routing of the field wiring within the enclosures. Contractor wiring within enclosures shall be neatly arranged and shall not be directly fastened to the enclosure frame. All internal interconnection wiring and cables shall be routed separately from field wiring to the RTU terminals & power wiring. All wiring shall use copper conductors and have flame retardant insulation. Conductors in multi-conductor cables shall be individually color coded.

The use of non-flammable, self-extinguishing, plastic wire troughs is permissible. Metal clamps must have insulating inserts between the clamps and the wiring. Wiring between stationary and movable components, such as wiring across door hinges or to components mounted on extension slides, shall allow for full movement of the component without binding or chafing of the wiring.

2.5.22 Wiring/Cabling requirements

Shielded (screened) cables shall be used for external Cabling from the RTU panels. These external cables (except communication cables) shall have the following characteristics:

(a) All cables shall have stranded copper conductor.
(b) Minimum core cross-section of 2.5 mm^2 for PT cables, 4 mm^2 for CT cables and 2.5 mm^2 for Power & Control outputs and 1.5mm^2 for Digital Status inputs, transducer mA current output
(c) Rated voltage Uo/U of 0.6/1.1KV
(d) External sheathing of cable shall have oxygen index not less than 29 & temperature index not less than 250. Cable sheath shall meet fire resistance test as per IS 1554 Part- I.
(e) Shielding, longitudinally laid with overlap.
(f) Dielectric withstand 2.5 kV at 50 Hz for 5 minutes
(g) External marking with manufacture's name, type, core quantity, cross-section, and year of manufacture.

The Communication cable shall be of shielded, twisted pairs and of minimum 0.22sq mm size.

2.5.23 Terminal Blocks

Terminal blocks shall be having provision for disconnection (isolation), with full-depth insulating barriers made from moulded self-extinguishing material. Terminal blocks shall be appropriately sized and rated for the electrical capacity of the circuit and wire used. No more than two wires shall be connected to any terminal. Each analog input signal, digital status input and digital output signals shall require two terminals per point plus a common shield termination for each cable.

All terminal blocks shall be suitably arranged for easy identification of its usages such as CT circuits, PT circuits, analog inputs, status inputs, control outputs, auxiliary power supply circuits, communication signals etc.

Terminal Blocks for CT circuits shall have feature for CT shorting (on CT side) & disconnection (from load side) to facilitate testing by current injection. Similarly, TBs for PT circuit shall have feature for disconnection to facilitate voltage injection for testing.

2.5.24 System Architecture

Bidder has the option to offer RTUs having following system architectural design:

(a) Centralized RTU design where all I/O modules are housed in RTU panel and communicating with master station through communication port.
(b) Distributed RTU design where I/O modules are contained in the respective MFT/MFM and are housed in respective bay C&R panels. The RTU shall acquire analog and digital data from these MFTs/MFMs over standard protocols such as IEC – 101/104 or DNP 3.0 for further communication with master station.

The bidder shall asses the requirement of RTU panels based on the system design and supply panels accordingly.

2.5.25 Transducer

All transducers shall use a 48 V DC auxiliary power supply as provided for the RTU. All transducers shall have a maximum power consumption of 10 watts.

Transducer Protection

The input, output and auxiliary circuits shall be isolated from each other and earth ground. The transducer output shall be ungrounded and shall have short circuit and open circuit protection. The transducers shall

comply with the following requirements, in addition to the requirement of IEC 60688, without damage to the transducer:

(a) Electromagnetic Compatibility: IEC 61000-4-3, Level 1

(b) Electromagnetic Compatibility: IEC 61000-4-4, Level 1

(c) Shock Resistance: Minimum severity 50 A, IEC 68-2-27 requirements

(d) Vibration Strength: Minimum severity 55/05, IEC 68-2-6 requirements.

(e) Input Circuit Consumption: Less than 0.5 VA for voltage and current circuits.

Multi-function Transducer

The Multi-Function Transducers shall be used for acquiring real time analog & digital inputs and issuing digital output commands. The transducers shall be capable of bi-directional measurements as shall comply to the following specifications:

i. Wiring Configuration: 3 phases 4 wire /3 phase 3 wire, CT/PTs circuits.
ii. Nominal Input Voltage: 110 V (Ph- Ph voltage)
iii. CT Input: 1A/5A (per phase current).
iv. Display: Single line, bright LCD.
v. PT ratio and CT ratio should be programmable at site.
vi. CT Withstand Capacity: 3 times RMS continuous and at least 20 times for 1 sec.
vii. CT Burden: < 0.1 VA
viii. Voltage Withstand Capacity: 1 kV Continuous and 2 KV for 1 sec.
ix. PT Burden: < 0.15 VA
x. Communication Speed: < 50 milli-sec.

The Multi-Function Transducer shall have a local single line display to show the real time electrical parameters being acquired by the meter. The parameter(s) to be displayed shall be selectable through a push button.

Display parameters:

i. Three Phase Voltage
ii. Three Phase Current
iii. Frequency
iv. Per Phase & Total Power Factor (PF)., Lag/Lead
v. Per Phase & Total Active Power (MW), Import /Export
vi. Per Phase & Total Re-Active Power (MVAR) Import/Export
vii. Per Phase & Total Apparent Power (MVA)
viii. Import & Export Energy

The Multi-Function Transducer shall comply to the EMI/EMC level test requirements as specified for the RTU except for Fast transient burst test requirement which shall be for level 4. The test reports shall be submitted by the vendor during detailed engineering.

Mutai function transducers shall provide at least the following parameters as a minimum with the specified accuracies.

Sr. No.	Parameter	Accuracy
(i)	Voltage	±0.2%

(ii)	Current	±0.2%
(iii)	Frequency	± 0.02%
(iv)	Active Power/Reactive power	±0.2%
(v)	Power Factor (measuring range shall be 0.6 to 1.0 lag & lead)	

The parameters to be acquired from multifunction meters shall be selectable. MFT shall provide the 15-minute values (configurable 5minute/15 minute/1 hour) of Active Energy Import, Active Energy Export, Reactive Energy Import and Reactive Energy Export.

i. Accuracy Standard for Analog Signal: IEC60688 ,0.2
ii. Accuracy Standard for Energy: IS 14697/IEC 62053: 22 ,0.2S
iii. Aux. Power Supply: 48VDC/110 VDC/220 VDC
iv. Communication Port: Isolated RS 485
v. Communication protocol: Modbus RTU
vi. Mounting: DIN rail mounted.

Optional Features:

i. Digital Inputs having dry contact Potential free or wet contact 48/110/220 VDC
ii. Digital Outputs
iii. Communication Port: Isolated RS 485 Serial / Ethernet
iv. Communication Protocol: IEC 60870-5-101/104 & DNP 3.0

Multi-function Meter

The Multi-Function Meters shall be used for acquiring real time analog & digital inputs and issuing digital output commands. The meters shall be capable of bi-directional measurements as shall comply to the following specifications:

i. Wiring Configuration: 3 phases 4 wire /3 phase 3 wire, CT/PTs circuits.
ii. Nominal Input Voltage: 110 V (Ph- Ph voltage)
iii. CT Input: 1A/5A (per phase current).
iv. Display: Three display simultaneously, bright LED.
v. Display Size: min. 12 mm
vi. PT ratio and CT ratio should be programmable at site.
vii. CT Withstand Capacity: 3 times RMS continuous and at least 20 times for 1 sec.
viii. CT Burden: < 0.1 VA
ix. Voltage Withstand Capacity: 1 kV Continuous and 2 KV for 1 sec.
x. PT Burden: <0.15 VA
xi. Communication Speed: < 50 milli-sec.

The Multi-Function Meter shall have a local display to show all the real time electrical parameters. The parameters being displayed shall be selected through a push button and auto scroll basis.

Display parameters:

i. Three Phase Voltage
ii. Three Phase Current
iii. Frequency
iv. Per Phase & Total Power Factor (PF)., Lag/Lead
v. Per Phase & Total Active Power (MW), Import /Export

vi. Per Phase & Total Re-Active Power (MVAR) Import/Export
vii. Per Phase & Total Apparent Power (MVA)
viii. Energy parameters.

The Multi-Function Meters shall comply to the EMI/EMC level test requirements as specified for the RTU except for Fast transient burst test requirement which shall be for level 4. The test reports shall be submitted by the vendor during detailed engineering.

Mutai function Meter shall provide at least the following parameters as a minimum with the specified accuracies.

Sr. No.	**Parameter**	**Accuracy**
(i)	Voltage	±0.2%
(ii)	Current	±0.2%
(iii)	Frequency	± 0.02%
(iv)	Active Power/Reactive power	±0.2%
(v)	Power Factor (measuring range shall be 0.6 to 1.0 lag & lead)	

The parameters to be acquired from multifunction meters shall be selectable. MFM shall provide the 15-minute values (configurable 5minute/15 minute/1 hour) of Active Energy Import, Active Energy Export, Reactive Energy Import and Reactive Energy Export.

i. Accuracy Standard for Analog Signal: IEC60688 ,0.2
ii. Accuracy Standard for Energy: IS 14697/IEC 62053: 22 ,0.2S
iii. Aux. Power Supply: 48VDC/110 VDC/220 VDC
iv. Communication Port: Isolated RS 485
v. Communication protocol: Modbus RTU
vi. Mounting: Flush Panel

Optional Features:

i. Digital Inputs having dry contact Potential free or wet contact 48/110/220 VDC
ii. Digital Outputs
iii. Communication Port: Isolated RS 485 Serial / Ethernet
iv. Communication Protocol: IEC 60870-5-101/104 & DNP 3.0

Transformer Tap Position Transducer

The existing transformer tap position indications are of two types.

(i) Variable resistance type

(ii) Lamp type

The Contractor shall provide suitable resistance tap position transducers which shall have the following characteristics

a) The input measuring ranges shall be from 2 to 1000 ohms per step, which is tunable at site with at least 25 steps.
b) Dual output signal of 4 to 20 mA DC, 0.5% accuracy class as per IEC 688 shall be provided. One output will be used for driving a local digital indicator (to be provided by the contractor) and the other will be used for interfacing with the RTU.
c) In case of lamp type, additional resistance/potentiometer unit shall be provided to convert the dry type contacts to a variable resistance as defined in (a) above, suitable for the remote indication.

2.5.26 Portable Configuration and Maintenance Terminal (PCMT)

Contractor shall supply a Portable Configuration and maintenance Terminal (Laptop PC) which shall provide followings capabilities:

a) RTU Data base configuration & Maintenance
b) Local Operator Interface & RTU Diagnostics
c) Master Station and RTU simulator cum protocol analyzer

RTU Data base configuration

The **RTU database Configuration** software being supplied with the PCMT shall have the following features

a) Full graphics windows User Interface
b) Standard editing capabilities e.g. cut, paste, copy, sorting etc.
c) Capable of controlling revisions of various RTU database files and storing multiple versions of databases for all the RTUs.
d) Capable of uploading database from the RTU and compare that with another version of database stored in the PCMT.
e) Provide standard template for database modelling required for I/O modules, MFTs & IEDs, communication setting.
f) Provide mapping of the individual data points acquired from one protocol to another protocol for transmission.

The database configuration software shall use the same terminology for configuration of the various protocol parameters as specified in the communication protocol standard i.e. it shall be possible to define these parameters by the user discreetly. Also, it shall be possible to select an ASDU type to be used for transmission of a measured e.g. measured value to be transmitted as ASDU 9 or ASDU 11.

Local Operator interface and RTU diagnostics

The Local **Operator interface** software shall support operator inquiries to demand status and data values of various RTU points, or an overall substation snap-shot, or of the status change buffer.

The local operator interface software shall provide the following reports:

i) Status Reports: Display of all substation status indications, of all telemetered values, and the RTU's status.

ii) Event Report: Display all the stored events in the event buffer of the RTU.

iii) Print Request: Provide user interface for requesting print out of the Reports on the Logger

iv) Maintenance activities: User interface for interacting with the RTU for maintenance activities like diagnostics, database online requests.

The **RTU** shall have inbuilt features for monitoring the healthiness of the RTU modules and detecting the type of error. The **diagnostics software** shall have diagnostics for the RTU's processor(s), memory, I/O

ports, and any other functional areas of the RTU. It shall list the errors recorded by the RTU and provide troubleshooting tools for the RTU.

Master station-cum-RTU simulator & protocol analyser software tool

The Master station and RTU simulator cum Protocol Analyzer software shall be used to monitor and test the RTU's operation using the master station communication protocol. It shall have the following features

a) capable of emulating both the master station and the RTU messages in all the communication protocols used in the RTU, subject to the minimum of IEC 60870-5-101, 104 & MODBUS. When the Master station and RTU simulator cum Protocol Analyser software has received or transmitted a message, it shall be possible to immediately "turn around" and transmit or receive a response message.
b) capability of interfacing to digital side of the RTU for the above purpose.
c) capable of receiving single and repeated messages using the supplied RTU communication protocol. Each received message shall be checked for validity, including the checksum code. The messages shall be displayed in HEX format or in the ‘interpreted form’ as desired by the user. It shall maintain and display error counters so that the number of errors during a period of unattended testing can be accurately determined.
d) capable of formatting and transmitting, both as one-time and periodic transmissions, any master station-to-RTU command.
e) capable of preparing illegal messages, such as messages having invalid check codes, for transmission.

The Master station and RTU simulator cum Protocol Analyzer software shall also be capable of passively monitoring all communication traffic on a channel without interfering with channel operation.

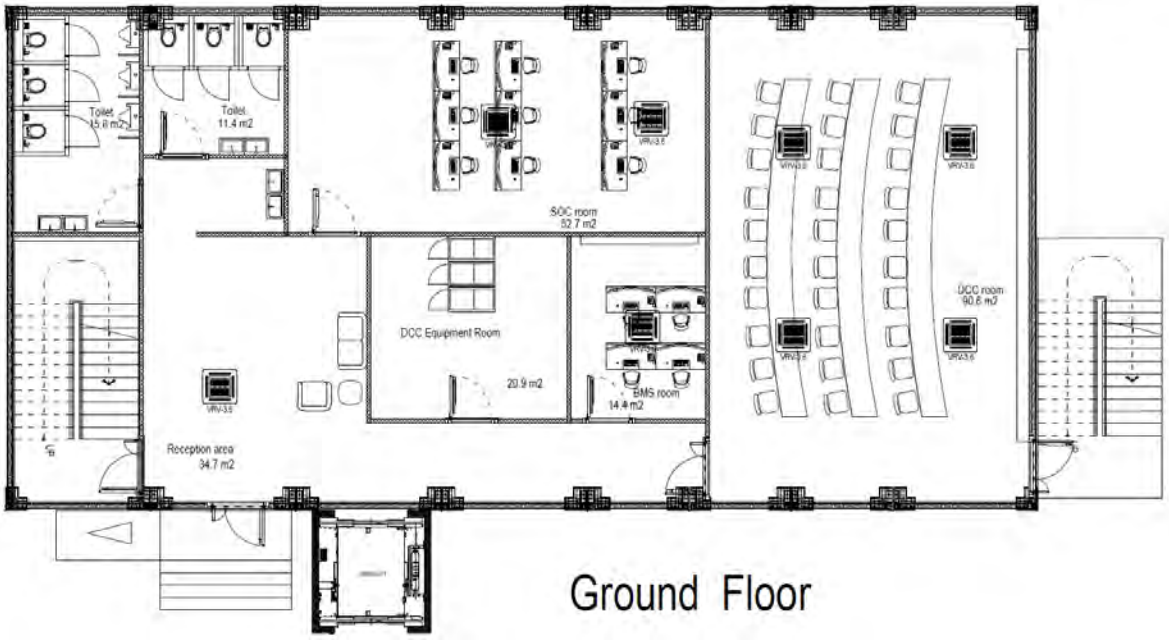
Channel traffic captured in the active or passive modes of operation shall be displayed. All fields of a message shall be displayed. A pass/fail indication for the security check code shall be included with each code displayed.

3. Building civil work and accessories requirements (from 9.2 Check)

3.1 Building civil work and Conveyance System

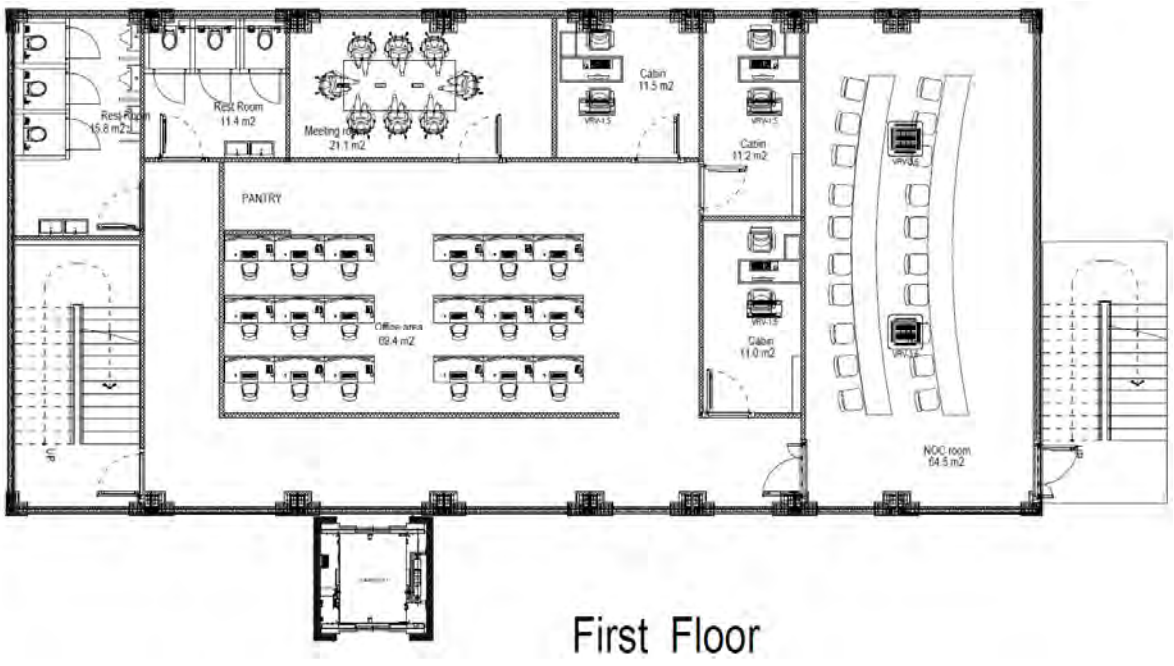
3.1.1 General Requirements

The building should be built by Pre-fabricated module, which should be module design and pre-fabricated in factory. The module dimension should be 40ft length * 2438mm & 3495mm width * 3600mm height. The building is with 3 floors, the detail layout plan is as below.



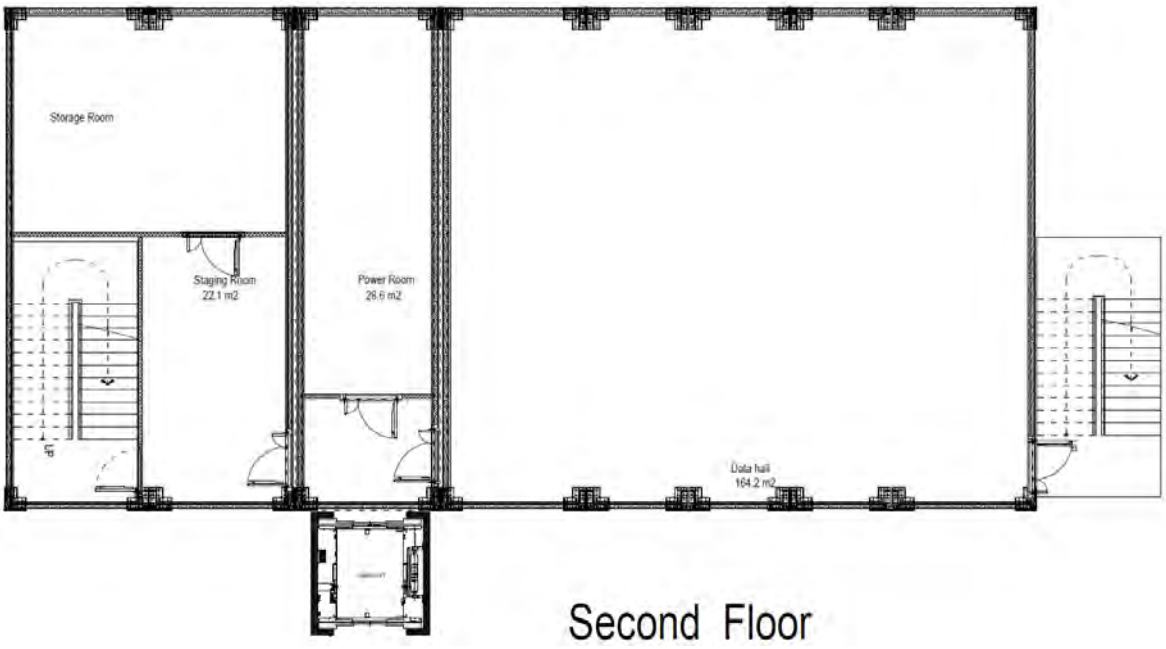
Ground floor Layout plan

Reception area: 34sqm; DCC equipment Area: 90sqm; DCC Equipment Area: 20 sqm; SOC Room:50 sqm; BMS room: 14sqm; M-Rest Room: 3 peole; F-rest room: 3 people.



First floor Layout plan

NOC room: 64 sqm; Office Area: 65 sqm; meeting Room: 20 sqm; 3 cabin room: 10 sqm per each; M-Rest Room: 3 people; F-rest room: 3 people.



Second floor Layout plan

Datahall: 160 sqm; power room: 28 sqm, staging room: 22 sqm, storage room: 20 sqm.

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, leakproofness, 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.

3.1.2 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 3.6m.
- The recommendation dimension of pre-fab module is 3600mm×2438mm×12192mm (H*W*D), 3600mm×3495mm×12192mm (H*W*D). For the convenience of transportation and installation, the width and length of the prefabricated modules should be 2438mm×12192mm, 3495mm×12192mm.
- The building should support minimum 3-layer stack deployment. The Civil foundation shall be designed to accordingly for 3-layer stacking and can meeting Nepal Building seismic requirements The data center 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 no less than UL 1440 hour salt spray test and provide third party reports.
- Steps, stairs and ramps are to be provided to access all the prefabricated modules.
- The building construction provider must have no less than 5 cases that building is construct by pre-fab module which no less than 3-layers, and no less than 40 cases that building is construct by pre-fab module.
- 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 DC room should be pre-assembled and pre-tested in factory no less than 80% and can support FAT in factory.

3.1.3 Prefab Module Requirements

3.1.3.1 The building codes and specifications

The structural design is in accordance with the following codes and specification

(1) General construction in steel code of practice IS800 2007

(2) Criteria for earthquake resistant design of structures, part1 General provisions and buildings, IS1893 (Part1):2015

(3) Code of practice for design loads (Other than earthquake for bui ldings and structures) IS875 1987-2016

3.1.3.2 Building Loading Capacity

The building loading should be design for minimum requirement as follow (as indicated in the BPS):

- Roof loading: 0.75 kN/m2
- Loading on top of the module: 0.6 kN/m2
- Data Hall loading: 8.4 kN/m2
- Power supply and distribution pumps and other supporting areas of load: 12 kN/m2
- DCC, SOC, NOC, Office, meeting room and other area loads: 5 kN/m2

3.1.3.3 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.

3.1.3.4 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 pre-fab module are combined to form a module building to provide all required function area、rooms.

Figure 1-1 Wide module

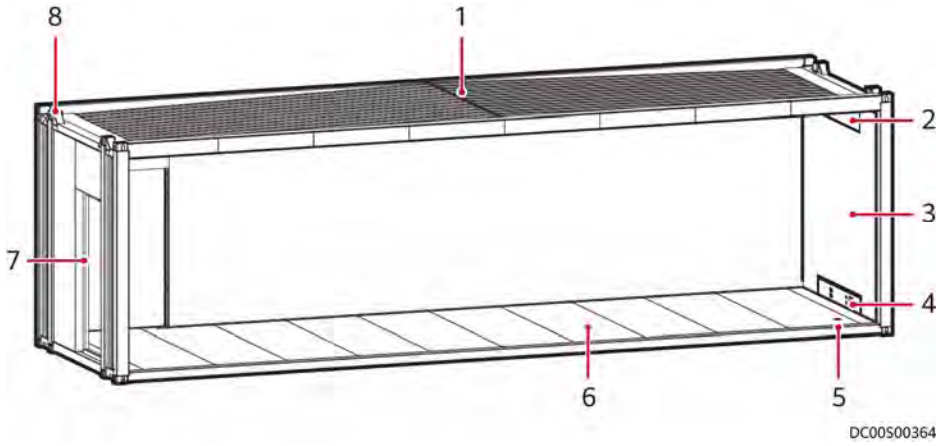
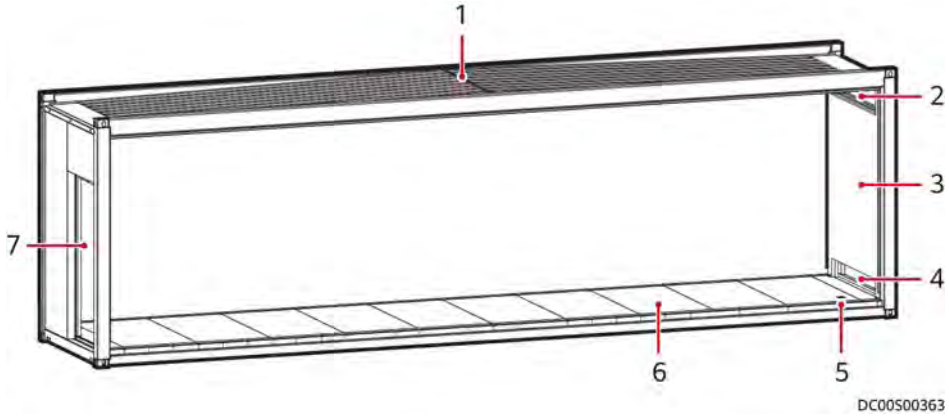


Figure 1-2 Standard module



(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

3.1.4 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 Datahall and Power room (cooled by precision air conditioner).

The VRV/VRF air conditioning system should be multi-connected, and cooling capacity 100kW, 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 can 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.

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 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 contractors 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.

3.1.5 Fire Extinguishing System

Pre-action fire sprinkler system (single interlock) shall be provided to protect the areas other than Datahall, power room, and DCC 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 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

3.1.6 Video Wall

The DCC/SOC/NOC room solution should consists of 4K LCD Video Wall solution based on 65-inch LCD panels in 3840 x 2160 (4K) resolution. It should be possible to show any of the input sources or all the input sources in any position on the wall, in any size and any configuration. To ensure no discontinuity of displayed information.

Configurations in DCC/SOC/NOC room are as below:

- DCC Room: 4K LCD video wall with 65-inch panels in 6(C) X 2(R) with controller and workstation
- SOC Room: 4K LCD video wall with 65-inch panels in 2(C) X 2(R) with controller and workstation
- NOC Room: 4K LCD video wall with 65-inch panels in 4(C) X 2(R) with controller and workstation

LCD display panel specification:

- Panel: 4K LCD panel
- Panel Size: 65 inch
- Aspect ratio: 16:9
- Brightness: 700cd/m2
- Resolution: 3840x2160
- Contrast ratio: 4000:1
- Screen to screen gap: under 3.5 mm

Controller specification:

- Chassis: 4 U chassis (including MPUs and power modules), 11 slots (6 for input boards and 5 for output boards)
- Interface: supports collection of signals from multiple UHD and IP sources, such as VGA, DVI, HDMI, BNC, SDI, YPbPr, HDTVI, DP, DVI dual-link, DisplayPort 2.0, and HDMI 1.4.
- Decoding capability: The decoding board can decode and display two channels of 800 W (two channels of 600 W, two channels of 500 W, eight channels of 1080P, 16 channels of 720P, or 32 channels of D1) network signals on the video wall, and play back local recordings on the video wall.
- Image segmentation: A single output port supports 1/4/9/16 image segmentation.
- Layer overlay: Supports a maximum of six layers, including a virtual LED layer and a base layer. The font size and background color of the virtual LED can be adjusted. The LED scrolling mode can be selected. The base image resolution can reach 16384 x 8192.
- HD/3G SDI synchronous output display;
- The built-in matrix function supports simultaneous display of multiple windows of a single signal source. Supports signal windowing and roaming.
- The SADP can automatically search for IP addresses and reset administrator passwords.
- Supports connection adjustment of the display wall. The virtual display wall window on the client can correspond to any output port on the controller.

- The client provides the function of previewing video signals to be pushed to the video wall, which facilitates signal invoking.
- The client can manage a maximum of 16 devices. A maximum of four virtual video wall can be displayed on the video wall.
- Supports iPad client and web control.
- Ultra-high resolution splicing: A maximum of 16 4K signal sources can be spliced to form a complete image.
- The fan speed of the chassis is adaptive to the temperature.
- Supports video wall display and preview of the signal source list.

Workstation specification:

- Processor: Intel Latest generation core i7
- Operating System: Latest Windows professional version
- Memory: 8 GB
- Hard drives: 1TB SATA HDD.
- Graphics: HD graphics card
- Connectivity: RS 485, USB, HDMI out, LAN
- Monitor: 17" LED monitor

3.1.7 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 socketed and shall conform to IS 1239. All fittings shall be malleable iron galvanized fittings of approved best Indian make. 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 nut and is not greater than 1/2 of the diameter of the screw. The nuts 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 pipe.

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 coarse 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.

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3.1.8 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: 3 (3 floors with 4.15m height per floor)
- Travel speed: 1 m/s.
- Motor Location: Top based Machine room or as Manufacturer's recommended
- Car groups: only 1 car
- Car Door Size: 1400 mm (W) x 2400 mm (H)
- Well Size: as Manufacturer's 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.

3.2 Building interior decoration requirement (DCC/SOC/NOC/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, 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 color 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 and 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, color steel composite gypsum board veneer, 3000 mm high, and stainless steel baseboard. Office rooms use latex paint walls and stainless steel baseboards. The color steel plate is dustproof, easy to clean, does not generate glare, has a strong structure, and is durable and environment-friendly. In addition, the color steel plate must meet the fireproof requirements. Is the market with a good reputation in high-grade products; The color 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 aluminum 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

Furiture should be 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

4. Software Requirements

4.1 Overview

This section describes the characteristics of system software such as Operating system, RDBMS and support software (programming language compilers, database development and maintenance, display development, network services, Report generation, diagnostics and Backup utilities) provided by Contractor as necessary to support the SCADA/DMS applications. This section also describes the standards to be followed for all supplied software.

4.2 Software Standards

All DMS software provided by the Contractor, including the Operating system, RDBMS and support software, shall comply with the industry-accepted software standards produced by national and international organizations, such as ANSI, ISO, IEC, and IEEE, or widely accepted de- facto standards put forth by industry consortiums, such as OSF and X/Open to facilitate maintenance and enhancement of the SCADA/DMS system is being supplied. In general contractor shall support “open system in DMS" objective promoted by industry standards groups. Software should be Hardware independent i.e. not factory coded All DMS applications shall be maintainable by employer using the supplied software utilities and documentation. The DMS software design and coding shall enable expandability, modularity and portability/ interoperability. The use of proprietary system services software shall be discouraged.

4.2.1 Design and Coding Standards for SCADA/DMS applications

All SCADA/DMS applications shall be maintainable by employer using the supplied software utilities and documentation. The SCADA/DMS software design and coding standards shall also address the following:

a) Expansion/ scalability: software shall be dimensioned to accommodate the ultimate size of SCADA/DMS system envisaged.
b) Modularity: software shall be modular to minimize the time and complexity involved in making a change to a program.
c) User-Directed Termination: Functions taking long execution times shall recognize and process user requests to abort the processing.
d) Programming languages: The software shall be written using ISO or ANSI or ECMA standard programming languages (like FORTRAN, C, C++, and SQL and for Unix based systems the APIs shall be POSIX-conforming.
e) SOA architecture: Software shall conform to SOA.
f) Enterprise service bus (ESB): ESB based architecture is essential to enable interaction of applications from different product manufacturer, platforms etc.
g) Portability & Interoperability: The software shall be designed for hardware independence and operation in a network environment that includes dissimilar hardware platforms to the extent possible. The use of system services software shall be built on Open standards.

Hardware needs technical specification to be specified by the Vendor clearly for this SOFTWARE requirement. Software to be designed as per the I/O requirement below mentioned:

- No. of Substations– 40
- No. of Feeders – 400
- No. of DI Inputs – 15000
- No. of DO Commands – 1200
- No, of AI Signals – 6000
- No of Switching Stations- 50
- No. of Feeders – 500
- No. of DI Inputs – 15000
- No. of DO Commands – 5000

- No. of AI Signals - 25000

This is basic as envisaged upcoming sub-stations and switching stations at Kathmandu as declared and in near future at is adjoining and can be further scaled to 50%.

Other Application parameters like Accumulated objects, corresponding alarm groups, delay groups, RTU internal events and SCADA server diagnostic events etc. to be considered.

External interface provision for future SCADA based software applications should be made available.

Data Information storage & retrieval shall have retention of minimum 5 years measure and data & 2 years for events data at actual scan frequency of data received through specific / necessary software tools through self or third-party interface software. All the Software/License requirements as per the proposed architecture shall be clearly mentioned during the bidding process. No request of additional licenses will be entertained at the later stages. Necessary License for Historian Database Software's should be provided for generation of front end reports and applications.

4.3 Operating System

The contractor shall use Linux or Microsoft Windows™ for Application and Database Servers and Windows shall be used for Data Engineering/Operator Workstations/Front End servers.

4.4 Time and Calendar Maintenance

The SCADA/DMS system shall maintain Time and date for use by various software applications. The GPS based time receiver shall be used for synchronizing the SCADA/DMS system time. All Servers and Operator workstation clocks shall be synchronized within the accuracy of +/-100 milliseconds.

The SCADA/DMS system shall not be dependent on a server for time /calendar maintenance. The SCADA/DMS shall include two redundant time and frequency standards. Failure of the online unit shall result in automatic switching to the redundant unit. The SCADA/DMS shall periodically check if the backup unit is operational and failure of either unit shall be alarmed. The frequency reading shall be accessible by SCADA/DMS applications with three post-decimal digits resolution the system shall support communication protocols such as NTP and SNTP. The time and frequency standard unit shall support a common time code output format such as IRIG-B.

A surge protection system shall be included to prevent the time and frequency standard equipment from lightning.

4.5 Cyber Security of SCADA DMS System

SI shall provide end-to-end cyber security services to meet IT security challenges for SCADA DMS system based on the proven frameworks and security best practices. It is vital that the processes and technology supporting the Information Security function for SCADA DMS system are proven and compliant to best practices/ standards. It is envisaged that the cyber security operations shall be centralized, structured, coordinated and responsive resulting in effective cyber threat prevention and detection, thereby securing SCADA DMS system from attackers. The Information Security functions shall respond faster, work collaboratively, and share knowledge more effectively. SI shall bring advanced data analysis and forensics insight to provide the following services to NEA.

4.5.1 Security during Development & Integration Phase:

System Integrator shall meet the security requirements listed below (including but not limited to) during the development and integration stage:

- SI shall address emerging cybersecurity vulnerabilities in their software coding under System Development Life Cycle (SDLC). This should be done by taking into consideration the SANS Top 25 Most Dangerous Programming Errors and the OWASP Top 10 Project.
- SI shall propose a legacy data cleansing approach.
- SI shall propose a security mechanism to be used for API and adopt the best practices such as OWAPS guidelines to ensure security.
- SI shall promptly notify UHBVN & DHBVN when vulnerabilities are found in their code.
- SI shall apply security related patches and updates.
- Remote access by SI will only be performed using technology authorized by SCADA DMS system.
- Any data interfaces implemented or built by Bidder will be required to have encryption and authentication (strong authentication when possible.)
- Files containing NEA information will be transferred using encrypted file transfer techniques agreed upon by both parties.

4.5.2 Security for Operations and Maintenance phase:

Security Policy

- System Integrator (SI) will adopt leading information security framework (such as ISO 27001:2013, ISO 22301:2012) and define monitor and update the security policies including Servers, network, application.

Incident Response

- SI shall do the analysis of application and network, do post-incident reporting, and implement practices to ensure a rapid response to attacks. A priority structuring for various security incidents and issues. SI shall do a proactive review of incident response plan to improve incident response time and implement continuous improvement process to strengthen overall effectiveness of security.

Distributed Denial of Service (DDOS) Protection

- SI shall secure SCADA DMS system against DDoS attacks such as network and application level attacks with minimal business disruption. It must keep the businesses up and running at high performance levels even under attack, avoiding any monetary losses and serious reputation damage.

Malware Analysis

- System Integrator (SI) shall conduct analysis of newly discovered malware to uncover its scope and origin. Perform dynamic real-time analysis of advanced malware identified and prevent true zero-day and target attacks which can aggressively evade signature-based defenses through various channels such as Web, Email & Files.
- SI shall perform the threat analysis of unwanted or suspicious malwares by the behavior or signature based deduction and take input from the logs, detection, vulnerability or suspicious activities feeds IOC.

User Authentication and Control

- SI shall define and implement highest level of access governance. The proposed of this solution is to have an enhanced user role security where access should be restricted to only authorized users with multi-factor or two-factor authentication.
- The system should have access control features for controlling the access rights over the system and over the various functions/features available for different types of users. Best

practices from enterprise security including password strength, password aging, password history, reuse prevention etc. must be followed for access control.

- Application user authentication and authorization related transactions should be encrypted and used a wide array of authentication schemes, standards or token types to ensure that only valid users and applications get access.
    - SI must ensure that end user access to servers is through SSL, VPN.
    - SI must ensure to have built-in user-level controls and administrator logs for Transparency and audit control.
    - SI must ensure to have access control policy and ensure role level access control employed with ability to manage roles & identity centrally.

Anti-Virus

- SI shall provide Latest version of anti-virus should be installed on servers at entire infrastructure

Hardening

- All unnecessary packages must be removed and/or disabled from the system. Additionally, all unused operating system services and unused networking ports must be disabled or blocked. Only secure maintenance access shall be permitted and all known insecure protocols shall be disabled.
    - SI shall provide consolidated view of the availability, integrity and consistency of the Web/App/DB tiers on DC
    - SI must ensure Database nodes (RDBMS) should be protected with higher security layer at DC

Security Audit

- System Integrator shall engage with a certified agency appointed by NEA and SI will cooperate fully with the auditor. The auditors shall be responsible to conduct the following activities:
    - Security Audit that include (but not limited to) vulnerability assessment, penetration testing, application security assessment API testing and Mobile application assessment biannually (once in six months) for entire infrastructure.
    - Implementation of information security controls and perform periodic (once in a year) assessment.
    - Propose ways to enhance the protection of SCADA DMS system & Supporting IT Infrastructure.
    - Ensure the applications are free from OWASP Top 10/SANS and CERT- Nep web/mobile application vulnerabilities as released from time to time.
- SI is responsible for mitigating all security risks found and continuous monitoring Activities. All high-risk vulnerabilities must be mitigated within 15 days from the date vulnerabilities are formally identified.

Source Code Review: Third party agency shall review the source code of web and mobile applications for hidden vulnerabilities and design flaws. It shall also verify whether security controls are implemented appropriately.

Secure Configuration Review: Third Party Agency shall review the security configuration SCADA DMS system and provide the detailed report that include the recommendations for remedial actions and submit the results to NEA.

4.5.3 Firewall

As per the proposed architecture given in Figure 2**:** Indicative Utility Architecture with Integrated Application and Services firewalls should be properly configured to segregate networks into different segments. The following strategies shall be followed for secure configuration of firewalls.

- Cleanup rule.
- Place a 'Deny Any-Any' rule at the end of the rule base.
- Never create an 'Allow any-any' rule.
- Allow rules should be created only for required services.
- This will result in all traffic being disallowed, unless specifically allowed.
- Lockdown/stealth rule
- All traffic destined for the firewall itself should be disallowed.
- Anti-spoofing rule.
- Place anti-spoofing rule as per RFC 1918 and 2827.
- Enable DoS/DDoS features on Firewall
- Enable application level filtering of firewall

4.5.4 Intrusion Detection & Prevention System

The required features of the HIDS and NIPS are described below:

Intrusion Detection and Prevention System (Host Based):

Host based Intrusion Detection and Prevention System module shall be provided for all machines on DMZ LANs. IDS shall be able to perform following actions:

- Capability for Detecting the intrusion attempt that may take place, intrusion in progress and the intrusion that has taken place.
- Flag and check unauthorized access
- Notify/Alarm/message of intrusion to:
    - Management console
    - Event log
    - Administrator by e-mail
- Create an audit trail for user and file access activity, including file accesses, changes to file permissions, attempts to install new executables and/or attempts to access privileged services
- In an event where user accounts are added, deleted, or modified, changes to key system files and executables is done in by unauthorized account or there is an authorized attempt to overwrite vital system files, to install Trojan horses or backdoors suitable action should be taken such as:
    - Terminate User (intruder) Login
    - Disable User (intruder) Account
    - Forge a TCP FIN packet to force intruder connection to terminate
- Should provide events check for suspicious file transfers, denied login attempts, physical messages (like an Ethernet interface set to promiscuous mode) and system reboots.

Network based Intrusion Prevention System (NIPS):

The NIPS shall provide complete inline protection from network-based application layer threats by scanning packet payloads for malicious traffic. It shall detect, classify and stop malicious application, viruses, worms and spyware/adware etc. The NIPS shall be tightly integrated /in-built with the firewall.

After detecting an intrusion attempt NIPS should be able to perform following actions:

- Reconfigure the firewalls provided in this package
- Send an SNMP Trap datagram to the management console.

- Send an event to the event log.
- Send e-mail to an administrator to notify of the attack.
- Save the attack information (timestamp, intruder IP address, victim IP address/port, protocol information)
- Force intruder connection to terminate.

4.5.5 Gateway Antivirus

This shall be used for Gateway scanning of viruses. Gateway antivirus shall have Centralized-user Administration which will communicate directly with centralized user directories such as LDAP. It shall have the all the essential/standard features of Latest version of Gateway antivirus, some of the features are as following:

- It shall have Policy-based URL filtering and Dynamic Document Review.
- It shall protect web traffic with high-performance, integrated virus scanning and web content filtering at the gateway
- It shall ensure protection by combining list-based prevention with heuristic content analysis for both virus protection and web content filtering
- It shall eliminate unwanted content and malicious code & Scan all incoming and outgoing HTTP and FTP traffic etc.

The Security System shall use the best practices to prevent the System itself being a source of security compromise. The System shall be hardened, patched, tested, and designed with security as a primary objective. Communication with (GUI and notifications) and within (agent reporting and updates) the System shall use encryption and authentication.

4.5.6 Other aspects of security

Application Security Monitoring

The standard operating system shall support the monitoring of security on host installed applications. The system shall support or allow the creation of monitoring for:

- Application Software Error Conditions
- Application Software Performance Issues
- Application Configuration Changes
- Application Logins, etc.

Security Alarms

The system shall be capable of annunciation, to include audible and visual alarms and remote paging whenever a security event takes place and shall support the following:

- Instant notification through email or pager
- Logical grouping of security events by time, location, and device, etc
- Interactive dashboard window for viewing and acknowledgement

Analysis and Reports

The system with the stored information, shall be able to produce analyses and reports to meet security compliance requirements. The system shall be equipped with best practices ad-hoc reports widely used in the industry.

The employer's personnel shall be trained to can create new custom analysis and reports, and revising existing, without requiring external consultation.

Log Archiving

The security system shall archive, record, and store all security related events in raw form for at least one year. As a minimum, the event logger shall record all security related events from the perimeter security devices and the host IPS. Graphical trend displays of each event shall be available along with specific information on the type of intrusion, the area affected and the source via IP address.

Data Access through intranet

The Web server at Control Center is to function as source of information on the distribution network. It will be accessed by utility intranet user. Any additional client software, if required, at external clients/users ends, the same shall be made dynamically available from Web server for its downloading by these external clients. There shall not be any restriction to the number of clients downloading this software (i.e. Unlimited number of client downloads shall be provided). The external users shall be licensed users of the employer. The following features are required:

a) The Web servers shall be sized to support at least 50 concurrent external intranet clients/users for providing access to real-time data.
b) External intranet clients/users shall be connected to the web servers through secure authentication such as VPN access. These users shall be denied direct access to the SCADA/DMS protected LAN.
c) Internal SCADA/DMS users shall not have any dependency on the availability of the Web servers.
d) For transfer of data/displays/ from the SCADA/DMS system to the Web server system, the SCADA/DMS system shall initiate a session with the Web server and any attempt to initiate a session by the Web server shall be terminated by the Firewall in SCADA/DMS system LAN. Interface between Web server and SCADA/DMS zone shall preclude the possibility of external clients defining new data/Report/Displays. For any sessions initiating from the DMZ LAN into the protected LAN, the servers shall be in a separate DMZ LAN that will be isolated from common applications connected directly to ISP such as email. The Access to these servers from the external web will be through authorization of Virtual Private Network.
e) The web server shall provide access to allowable real-time data and displays, at defined periodicity, for viewing by external clients/users. The access to each display shall be definable on per user type basis. It shall be possible to define up to 100 users. Further the SCADA/DMS system administrator shall exercise control over the real-time displays which can be accessed through the Web server.
f) The Web server at Control Center shall also facilitate exchange of email messages from ISP (Internet Service Provider) and other mail servers supporting SMTP.
g) Suitable load balancing shall be provided among the web servers where each shall serve proportionate number of clients. However, in case of failure of one of the servers, all the clients shall automatically switch to the other web server(s).

Typical displays/pages for Intranet access shall be same as that on the SCADA/DMS**.** Real time SCADA data on web server shall be refreshed every minute the access to Web server/site shall be controlled through User ID and password to be maintained /granted by a system administrator. Further, different pages/data access shall be limited by user type (i.e. CMD, Mgmt. user, in charge etc). The access mechanism shall identify and allow configuration of priority access to selected users. Further, tools shall be provided for maintaining the website, web server configuration, E-mail configuration, FTP configuration, Mailing lists setup and customer support. Latest protections against viruses shall be provided.

Signature Updating Requirements

The system shall be able to accept timely updates. The updates shall keep the threat signatures current, providing the latest detection and protection. The updates shall also incorporate the latest security enhancements into the Security Management System. These enhancements shall increase security and functionality, without requiring redesign or reengineering efforts.

4.5.7 Database structure

The SCADA/DMS RTDB (Real Time Data Base) shall be an active process model. i.e. It shall initiate actions or events based on the input it receives. The RTDB shall describe the state of the power system at a given point in time and the events that move the system to a new state at the next point in time. This database is required to support the data access to real time information and to allow efficient integration and update. A library of event routines may encapsulate or interface the RTDB with other components of the system. These event routines shall be the preferred means for application programs to interact with RTDB. This way, application programs (and programmers) only need to concern themselves with callable interface (API) of these routines. Each application shall interact with the RTDB through the event library. These event routines shall serve as generic APIs for database access thereby eliminating proprietary database function calls at the application level.

The SCADA/DMS shall include a single logical repository for all data needed to model the historical, current, and future state of the power system and SCADA/DMS – the Source Database (SDB). All information needed to describe the models on which the SCADA/DMS operates, shall be defined once in the SDB and made available to all SCADA/DMS applications, real-time database, and user interface maintenance tools that need the information.

Any database update, whether due to local changes or imported network model changes, shall be able to be placed online in a controlled manner without causing undue interruption to network operations, including without losing any manually entered data. For example, a network model update to introduce a new substation shall not interrupt the ability to perform supervisory control actions or receive telemetry to view the network state. It shall be possible the changes, local or imported, to be placed online either automatically or under manual control with proper validation. It shall be possible to easily revert to an earlier database version, again without undue interruption to network operations.

The capability to import & export the CIM compliant network model data including the corresponding telemetry and ICCP data reference in XML format to send it to other parties shall be provided. The capability to import the CIM compliant network model data from other parties in XML format shall also be provided. The SCADA/DMS shall provide a consistent interface to accept XML format data for updates from other database applications; and provide a consistent interface to import & export data in XML format.

4.6 Software Maintenance and Database development tools

4.6.1 General requirements

A set of software shall be provided to enable maintenance of application software and development of new software in software development mode. All hardware and software facilities shall be provided to allow creation, modification and debugging of programs in all languages that are supplied.

The following shall thus be possible:

- Program and data editing
- Program compiling and assembling
- Linking
- Loading, executing and debugging program.
- Version management
- Concurrent development

The following features shall be provided:

- Library management
- Programs allowing to copy and print any data or program files
- Backup and restore
- File comparison

- Sort and merge
- Programs that allow to partially save and recover volumes
- Core and memory dump.

In addition, tools shall have the following:

4.6.2 Command language

A complete command language shall be provided that allows interactive use of any console to interactively create, modify and debug programs in all languages provided. It should also be possible to create and save command procedure file and to execute it sequentially.

4.6.3 Linkage Editor and Loader

Compilers and assemblers, linkage editor and loader shall be provided to link object modules from an assembly or compilation to produce an executable module and load it in system. As far as possible, the loader shall accept object modules issued from various language compilers.

4.6.4 Symbolic Debugger

A language-independent, interactive symbolic debugger shall be provided to enable the user to test new software and inspect the characteristics of existing software. The execution of a program shall be under the control of the debugger according to parameters entered by the user. The following features shall be supported:

a) Program execution breakpoint control
b) Program execution sequence tracing
c) Display and modification of program variables
d) Attachment of specifically written debug code to the program under test.

4.6.5 System Integration

System integration services shall be provided for adding new programs to the set of active software after the programs have been tested. These services shall include commands to substitute one program for another, to set up or modify operating system tables, and to schedule and activate a new program with a minimum of interference with the normal running of the SCADA/DMS functions. The capability to restore the system to its status prior to the new program integration shall be provided.

4.6.6 System Generation

System generation software and procedures shall be provided to generate an executable object code of all software, databases, displays, and reports. Employer personnel shall be able to perform a system generation on site, using only equipment, software, procedures, and documentation supplied with the SCADA/DMS. It shall not be necessary to return to the Contractor's facility or rely on the assistance of Contractor personnel.

The contractor shall provide all software including all operating system in DMS, utilities, libraries, resources, application "engines", files (e.g., batch, command, and script files), and diagnostic programs required for generation of the delivered system. The format and media of the third-party software shall be that supplied by its manufacturer and used by the Contractor in building the system in DMS. The documentation of other software shall also be provided.

The procedures necessary to perform a complete system generation shall be provided as interactive or batch commands maintained on auxiliary memory and on archive storage, source listings, and detailed manuals. System generation shall be accomplished without programming; only directives or control commands described in the procedures shall be required.

4.6.7 Code Management

A code management utility shall be provided for documenting and controlling revisions to all SCADA/DMS application programs. The utility shall maintain a library of source, object, and executable image code and provide a controlled means for changing library files containing this code.

The code management utility shall include inventory, version, and change control and reporting features. Program dependencies shall be included in the library for user reference. The code management facility shall retain a complete history of additions, deletions, and modifications of library files. An integrated source code development subsystem supporting C, Fortran, Java, and C++, other programming languages used in the SCADA/DMS shall provide a software configuration management system to define the elements and the associated attributes of the applications provided in the SCADA/DMS. Source definitions for all elements of an application shall be maintained in disk files under a code management system. As a minimum, the code management system shall:

- Manage source code and binary images
- Allow tracking of code changes by date, author, and purpose
- Manage documentation modules and associate them with source code, binary images, and other documentation
- Support multiple teams of programmers working concurrently on the same modules
- Provide an efficient link between modules

4.7 Database Development software

The databases organization shall be designed to meet the following major functional requirements: Data consistency. Compliance with the system performance requirements including both response times and expansion capabilities,

Database development software shall be provided which shall contain database structure definitions and all initialization data to support the generation of all relational, real time database (RTDB) non- relational run-time databases required to implement the functions of SCADA/DMS system. All the facilities required for generating, integrating and testing of the database shall be provided with the SCADA/DMS system. The delivered SCADA/DMS database shall be sized for the ultimate system as described in this Specification. The database development facility shall be available on development system comprising of server & workstation. Once the database creation/ modification activity is over, the compiled runtime executables shall be downloaded to all respective machines. Executing the database generating functions shall not interfere with the on-line SCADA/DMS functions.

The database development function shall locate, order, retrieve, update, insert, and delete data; ensure database integrity; and provide for backup and recovery of database files. The database development function shall generate and modify all SCADA/DMS data by interfacing with all database structures. The location of database items shall be transparent to the user performing database maintenance.

Extensive reasonability, integrity, and referential integrity checks shall be made on user entries to detect errors at the time of entry. Invalid entries, such as entering an invalid data type or attempting to define contradictory characteristics for a database item, shall be detected and reported to the user in an error message. All error messages shall be in plain English. The user shall not be required to repeat steps that were correctly executed prior to the erroneous action. Help displays shall be available to provide additional, detailed information to the user on request.

All newly defined points shall be initially presented to the user with default values for all parameters and characteristics where defaults are meaningful. It shall also be possible to initialize a new database point description to an existing database point description. The user shall be guided to enter new data, confirm existing data, and change default values as desired.

All required entries for any database item selected for changes shall be presented to the user. When parameters are entered that require other parameters to be specified, the additional queries, prompts, and display areas required to define the additional parameters shall be presented automatically.

a) Add, modify, and delete telemetered, non-telemetered, or calculated database items and data sources such as RTUs/ FRTUs / FPI, data links, and local I/O.
b) Add, modify, and delete application program data
c) Create a new database attribute or new database type
d) Resize the entire database or a subset of the database

Redefine the structure of any portion of the database. The database tool for creation, editing, generation, export, import of ICCP database including complete definition, association, bilateral tables, objects etc shall be provided.

4.7.1 Run-Time Database Generation and Maintenance

The database development software shall generate incremental database changes as well as run-time (loadable) databases from the global source database (user entered database) Incremental structure changes in the source database such as addition of a bay or a substation shall not require regeneration of the entire run-time database. Based on the nature of the change, the database development software shall determine which portion of the database must be regenerated and which displays, reports, and software functions must be re-linked.

All errors that were not detected during data entry time but are encountered during run-time database generation shall be flagged. The database generation routines shall continue processing the database to detect all errors present in the database before terminating the generation task.

4.7.2 Data Retention

The database generation process shall retain and utilize data from the current SCADA/DMS database in the newly generated database, even when a newly generated database contains structure changes. Data to be retained across database generation cycles shall include, but not be limited to, quality codes, manual entries, tags, historical data, and tuning parameters.

4.7.3 Making Database Online

After an error-free database generation, the user shall be able to test the data-base in an off-line server prior to its use in an on-line server. The previous run-time database of the server shall be archived such that it is available to replace the new database upon demand. The archived database shall be deleted only when directed by the user.

Newly generated run-time databases shall only be placed on-line by user command. Following the assignment of a new database to a server and on user demand, the database management software shall access each SCADA/DMS server to ensure that all databases are consistent. Inconsistencies shall be annunciated to the user.

4.7.4 On-Line Database Editing

Selected database management functions and changes to a run-time database shall be possible without requiring a database generation. These shall be limited to viewing functions and changes to the contents, but not the structure of the database. On-line changes shall be implemented in all applicable SCADA/DMS run-time databases without system downtime. Changes shall also be implemented in the global database to ensure that the changes are not lost if a database regeneration is performed. On- line database editing shall not affect the SCADA/DMS system's reaction to hardware and software failures nor shall it require suspension of exchange of data among servers for backup purposes.

4.7.5 Tracking Database changes

The database manager utility shall maintain Audit trail files for all changes made by all users. The audit trails shall identify each change including date and time stamp for each change, and identify the user making the change. An audit trail of at least last 2 months shall be maintained and another audit trail maintaining records of who/when performed the edit operation shall be maintained for a period at least 2 months.

4.7.6 Initial Database Generation

The initial database shall contain all data required by the SCADA/DMS systems. Default values shall be used in consultation with the employer for data that is not provided by employer. Population and maintenance of the distribution network model should be possible by using the database maintenance tools to build the database from scratch. In addition, if required data already exists within the Employer's corporate Geographic Information System (GIS) or otherwise, the SCADA/DMS database functions should leverage this effort by providing an interface/adaptor to extract GIS data using the CIM international standard IEC 61970/61968 and automatically generate the complete Network Operations Model. The data extracted should include network device information, connectivity, topology, nominal status and non-electrical data such as cable ducts, land base data etc. Further Land base data can be sourced from GIS in Shape files or DXF.

4.8 Display Generation and Management

The Contractor shall provide necessary software tools for the generation and management of SCADA/DMS displays at DCCs. The employer prefers a centralized Display Generation and Management concept where all the display development/maintenance activity is performed at DCC are downloaded to them.

SCADA/DMS displays shall be generated and edited interactively using this display generation software delivered with the system. The display generator shall be available on development system & once the display/ displays creation/ modification activity is complete, the compiled runtime executables shall be downloaded on all workstations/servers.

The display editor shall support the important construction options like:

- Copy/move/delete/modify,
- Building at different zoom level,
- Linking of any defined graphics symbol to any database point,
- Pop-up menus,
- Protection of any data field on any display against user entry based on log-on
- identifiers
- Activation of new or modified displays for any application or across all applications of the system by a simple command that causes no noticeable interruption of on-line DMS system activity.

All displays, symbols, segments, and user interaction fields shall be maintained in libraries. The size of any library and the number of libraries shall not be constrained by software. The display generator shall support the creation, editing, and deletion of libraries, including copying of elements within a library and copying of similar elements across libraries. A standard set of libraries and libraries of all display elements used in the delivered SCADA/DMS system shall be provided. All libraries shall have directories that list all elements contained in the library. These directories shall be displayable and printable on demand. All libraries shall include a library compression facility that consolidates unused space created by removal of old elements to allow efficient reuse by added elements.

Displays shall be generated in an interactive mode. The user shall be able to interactively:

a) Develop display elements
b) Link display elements to the database via symbolic point names
c) Establish display element dynamics via database linkages
d) Define linkages to other displays and programs

e) Combine elements and linkages into display layers
f) Combine display layers into displays.

Execution of the display generator functions shall not interfere with the on-line SCADA/DMS functions.

All workstation features and all user interface features defined in this Specification shall be supported by the display generator software. An audit trail of all interactive generations and edits shall be maintained by the display generator software. An audit trail of last 10,000 edit operations shall be maintained and another audit trail maintaining records of who/when performed the edit operation shall be maintained for a period of one year by the display generator.

4.8.1 Display Elements

The elements available to create a display shall consist of graphic primitives, symbols, segments, and layers. These elements shall be available to be linked to the SCADA/DMS functions and dynamically transformed on the display as governed by linkages to the database.

Symbols

The display generator shall support the construction of custom symbols using graphic primitives and save these symbols in symbol libraries. The display generator shall support the addition, deletion, and modification of symbols, including the merging of one symbol with another to create a new symbol. Symbol size shall not be limited. Symbols shall be defined at an arbitrary scale factor selected by the user.

Segments

The display generator shall support the construction of display segments consisting of symbols, primitives, and dynamic linkages to the database and user interface. Typical uses of display segments are pull-down menus, bar charts, pie charts and common circuit breaker representations. The display generator shall be able to save display segments in segment libraries for later use. The SCADA/DMS system shall include a base library of segments commonly used by display builders.

The display generator shall support the addition, deletion, and modification of segments, including the merging of one segment with another to create a new segment. Segment size shall not be limited.

Segments shall be defined at an arbitrary scale factor selected by the user.

Dynamic Transformation Linkages

Dynamic transformations shall be performed on symbols and display segments based upon dynamic linkages to database variables. All linkages to the database shall be defined via symbolic point names. Each symbol or segment stored in a library shall include its dynamic transformation linkages, although the specific point names shall be excluded. Dynamic transformation linkages shall support the dynamic data presentation.

User Interaction Field

Using the symbols and segments described in the previous sections, the user shall be able to construct fields on the display that allow user interaction with the display. These fields may correspond to function keys on the standard console keyboard, pop-up menus and menu fields, and poke points. The display builder shall be able to assign linkages to these fields that will, once selected by the user, trigger standard library keyboard programs, special application subroutines, or programs specific to the display active on the console screen. These fields shall be assignable to field libraries and made available for use by the display builder. The SCADA/DMS system shall include a set of standard field libraries that are used for the application functions and the display build functions provided with the system.

Display Layers

Display layers shall be constructed by placing primitives, symbols, segments, pictures (such as JPEG format) and poke points onto a world coordinate space. The display generator shall support the following static transformation of primitives, symbols, and segments as the elements are placed on the layers:

a) Rotation of the element about a center point
b) Scaling of the element
c) Flipping the element about any axis
d) Snapping the element to a static grid whose dimensions (in pixels) may be varied by the user.

These static transformations shall apply to individual display elements and to sets of elements selected by the user. The display generator shall also support the replication (copying of elements to other locations within the layer and between layers) of individual elements and sets of elements.

4.8.2 Display Generation and Integration

The displays shall be constructed from the display elements described above. The display definition shall allow displays to be sized to meet the requirements of the SCADA/DMS application for which they are used; displays shall not be limited by the size of the viewable area of the screen. The display generation software shall allow unbroken viewing of the display image being built as the user extends the size of the display beyond the screen size limits. Each display shall include the display coordinates definition that will permit a user to navigate successfully to the portion of the display that is of interest.

It shall be possible for a user to build a new display starting with a blank screen, a DXF formatted file imported from another system, or an existing display. Each display shall consist of up to sixteen display layers. The definition of each layer shall include a range of scale factors over which the layer shall be visible. The display generator shall also support manual control of layer visibility, where the user of the display shall determine the layers on view. Each display may incorporate manually and automatically (by scale factor) displayed layers. The user shall also define the periodic update rate of the dynamic information on the display and any programs called before or after presentation of the display.

The display generator shall support the integration of new and edited displays into the active display library. During an edit session, the display generation software shall allow the user to store and recall a partial display. To protect against loss of display work when a server fails, the current work shall be automatically saved every five minutes (user adjustable) to an auxiliary memory file.

The display generator shall verify that the display is complete and error-free before integrating the display into the active display library. It shall not be necessary to regenerate any display following a complete or partial system or database generation unless the database points linked to the display have been modified or deleted.

Imported CADD Drawings

The display generator shall support the import of drawings, including power system one-line diagrams, developed by owner on Computer Aided Drafting and Design (CADD) systems. The drawings may be used in the SCADA/DMS system as the static background for displays. The display generator shall provide the capability to add, delete, and modify the dynamic information supplied to the drawings using the specified features of the display generation and management software. As necessary, employer will replace the static background by importing a new drawing from the CADD system and re-linking associated database elements. The display generator shall allow a user to update the dynamic information to reflect any changes required by the updated drawing.

4.9 Report Generation Software

The SCADA/DMS system shall include Report generation software facilities at DCCs to generate new report formats and edit existing report formats. The user shall be guided in defining the basic parameters of the report, such as the report database linkages as symbolic point names, the report format, the report activation criteria, the report destination (workstation, printer, or text file), and the retention period for the report data.

The user shall be able to construct periodic reports and ad-hoc queries via interactive, procedures. The capability to format reports for workstations and printers shall be provided. The user shall be able to specify the presentation format for periodic reports and ad-hoc query reports as alphanumeric display format, graphical display format, alphanumeric printer format or HTML files. The user shall be able to specify that processing functions, such as summations and other arithmetic functions, be applied to portions of the report data when the report is processed for display, printing, or file storage. The software shall provide for generation of reports that are the full character width of the printers and that use all the printer's capabilities, such as font sizes and styles and print orientation.

For report data editing, the user shall be able to obtain the data from a retained report, modify the data, repeat the inherent data calculations, reprint the report, and save it in a report retention file on auxiliary memory without destroying the original report.

The user shall also be able to access a retained report, modify its point linkages to the database, modify its format, and save it in a report retention file on auxiliary memory as a new report without destroying the original report. Executing the report generating functions in any server of the system shall not interfere with the on-line SCADA/DMS functions. The report generation software shall be used to construct all SCADA/DMS reports to be provided as part of the project.

4.10 System Generation and Build

System generation includes the activity of generating an executable object code of all databases, displays, and reports as required for SCADA/DMS system. System build is the process under which all the above executables and the executables provided for SCADA/DMS application software are ported to the SCADA/DMS system hardware and configuring to make it operational.

The contractor shall do the complete system generation and build as required for successful operation of the SCADA/DMS system. The contractor shall also provide the complete backup of the SCADA/DMS system in electronic media such as tapes, CDs, MO disks etc. Employer personnel shall be able to restore the SCADA/DMS system at site by using above backup tapes/CDs etc. The contractor shall provide the procedures necessary to restore the system from the backup tapes/CDs etc. The DR system shall always have updated set of system build. It shall be synchronized with the SCADA/DMS control center.

4.11 Application programming Interface

Application programming interface for at least the following SCADA/DMS functions in all the programming languages shall be provided:

a) Database access – read and write all attributes of database points in the runtime (real- time) database. The database points written in the database shall be subject to same data processing as done for data acquired from FRTUs/RTU/FPIs/ICCP data sources.
b) Supervisory controls – initiate supervisory control action and receive reports on supervisory control actions.
c) Alarming – initiate and manage alarms
d) Application program controls – initiate, schedule, and terminate any of the
e) SCADA/DMS applications

4.12 Software Utilities

The Contractor shall provide the software utilities required for software configuration and management at

DCCs. Some of the software utilities required to be delivered along with the SCADA/DMS system are described here. However, contractor shall supply all software utilities used to develop and maintain SCADA/DMS software, if specifically required by this Specification.

The software utilities shall operate on-line (in background mode) without jeopardizing other SCADA/DMS application functions that are running concurrently. Utility software shall be accessible from workstations, processor terminals, programming terminals, and command files on auxiliary memory. Multiple users shall have concurrent access to a utility program task, provided there are no conflicts in the use of peripheral devices.

4.12.1 File Management

File management utilities shall be provided that allocate, create, modify, copy, search, list, compress, expand, sort, merge, and delete program files, display files, and data files on auxiliary memory and archive storage. These facilities shall include:

a) Memory segmentation facilities to separate files into directories and logical paths
b) Capability to protect and unprotect files and directories
c) Logical file names to manipulate and access files

The file management services shall maintain a record of the auxiliary memory allocation of all programs, displays, and data. This record shall be available for display and printing upon request.

4.12.2 Auxiliary Memory Backup utility

Software utility, to take backup of auxiliary memory files of server and workstation onto a user- selected archival device such as LTO drives, shall be supplied. The backup utility shall allow for user selection of the files to be saved based on:

a) Server and workstation
b) File names (including directory and wildcard designations)
c) File creation or modification date and time
d) If the file was modified since the last backup.

Further a utility for taking image backup of auxiliary memory files of the Servers and workstations shall be provided. The utility shall allow restoration of the servers/workstation from this image backup without requiring any other software. An image backup of the as built system of each of the Servers/workstations shall be provided on a LTO Drives, which shall be used to restore the system.

4.12.3 Failure Analysis Utility

Failure analysis Utility shall be provided to produce operating system and application program status data for analyzing the cause of a fatal program failure. The failure information shall be presented in a condensed, user-oriented format to help the user find the source of the failure. The information shall be presented on displays and recorded for historical records and user-requested printed reports.

Failure analysis information shall include the following items:

a) Time and date of failure
b) The most recent operating system service routine requested
c) The pending, executing, and completed programs
d) I/O activity per system device at time of failure
e) The current system resource allocation
f) Contents of pertinent system software tables
g) Contents of hardware register.
h) Contents of mapping tables

i) The contents of main memory
j) Paging parameters and tables.

4.12.4 On-Line Monitoring Diagnostics

On-Line monitoring diagnostic programs shall be provided for verifying the availability of the backup equipment and for limited testing of devices without interfering with on-line operations of the SCADA/DMS system or the failover capability of the devices.

Redundant communication line interface equipment shall be tested by periodically retrieving data over these lines and checking for the ability to communicate with the redundant channel and for any errors. Designated backup server(s) and associated auxiliary memories shall be automatically tested for proper operation to ensure they are ready if needed for a fail over contingency. Any failure to perform diagnostic functions correctly shall cause an alarm to be issued.

4.12.5 Off-Line Device Test Diagnostics

Device diagnostics shall be provided for testing each SCADA/DMS device including processors, main and auxiliary memory, peripherals, workstations, data links, communication interfaces, and FRTUs/FPIs. These diagnostic routines shall provide comprehensive printout and user interaction capabilities.

The diagnostics shall operate automatically after initialization by the user. They shall report the status of each test to the initiating user and, if requested by the user, to any printer. The user shall specify the extent of testing (all or any combination of tests) to be performed and the number of times the test(s) must be repeated

4.12.6 Text Editor

A text editor shall be provided to create and maintain source code, DMS documentation, and other miscellaneous text. The user shall be able to create new text files, edit existing files, and save file edits as an audit trail. The text editor shall allow full-screen editing of text and permit a line oriented batch mode of operation. The user shall be able to work with several files or portions of files at the same time.

4.12.7 System Performance Monitoring Software

Software shall be provided in each server and workstation to monitor hardware and software performance continuously and store performance statistics. The performance monitoring shall occur in real-time with a minimum of interference with the normal **DMS** functions.

The performance statistics such as CPU utilization, RAM utilization, Auxiliary memory I/O utilization and LAN interface utilization shall be made available to the Network Management System using SNMP protocol. A tool shall be provided for gathering the above performance statistics for certain period to be used for Performance testing. The period over which the statistics are gathered shall be adjustable by the user, and the accumulated statistics shall be reset at the start of each period. The statistics shall be available for printout and display after each period and on demand during the period. The SCADA/DMS system shall include on-line services to enable, disable, and initialize individually each performance monitor function defined in the following sections.

4.12.8 Server Resource Usage Monitoring

The values calculated by the resource usage monitoring function in each server shall include:

a) Server busy time in percent
b) Total server idle time in percent
c) Server idle time during main/auxiliary memory transfers in percent
d) Total number of transfers to/from auxiliary memory
e) Total transfer time for each auxiliary memory in percent
f) Time in percent when one or more tasks were blocked waiting for memory

g) resources
h) Peak number of items in the various system and I/O queues
i) Page fault rate
j) Percent usage of the modified page file.
k) Maintain above statistics for at least 1 day for future analysis.

4.12.9 Program Resource Usage Monitoring

Performance statistics on individual programs in each server and on their associated operating system overhead shall be calculated by the system when requested. The user shall be able to specify the programs for which statistics are to be gathered, the period over which statistics are to be accumulated, and the statistics to be collected. A complete summary shall be included with all the accumulated statistics for each program over the specified time. The values shall include:

Server time used by the program in percent

a) I/O wait time in percent
b) Device usage statistics
c) Page fault rate
d) Time spent waiting for page faults in percent
e) Average number of pages in use in main memory
f) Average number of pages in use in the modified page file.

4.12.10 Other Utility Services

The SCADA/DMS shall include the following utility services:

a) Source code search logic for single or multiple patterns shall be included. Searches by selected files or all files shall be provided. When the search I successful, the source shall be identified (document name, line number in source document, source line text), displayed, and printed, as selected by the user.
b) Loading and storage of information from labelled portable media storage units as dictated by the requirements of this Specification.
c) On line access to user and system manuals for all software products (e.g., Operating System and Relational Database Software) and SCADA/DMS applications shall be provided with computer system.

4.12.11 Programmer Assistance

Interactive, programmer assistance displays shall be provided that describe the uses, syntax, sequence, and options of the software commands associated with all system services, software utilities, and SCADA/DMS application programs. The descriptions shall be accessible from any workstation or programming terminal.

4.12.12 Displays and Reports for Web server

The contractor shall provide utilities for preparing displays and reports suitable for Web application. These utilities shall be used to generate, all required displays and reports from the SCADA/DMS system displays and reports, automatically (without requiring rebuilding).

4.12.13 Antivirus Software

All computers and firewalls shall be provided with the latest antivirus software as on date of supply. The antivirus software shall have the capability of having its virus definitions updated from time to time. The contractor shall be responsible for the maintenance & update of the antivirus software.

4.12.14 Software Upgrade

The contractor shall be responsible for the maintenance & update of the antivirus/anti spyware/signatures/pattern definition for firewall/IPS and security patches on Operating system software up to AMC period.

4.12.15 Outage Management System

A separate application for OMS to be configured and programmed in the SCADA/DMS

5. ALARMS

Alarms generated by SCADA shall be classic limit violations, rate of change, uncommanded status change and alarms related to system health.

Each alarm shall represent a single abnormal condition. Alarms shall be presented with descriptive message, which shall be also intuitive and easily interpreted.

Complete list of alarms shall be available in the system, and shall be accessible through the alarm summary. Alarm summary shall be an ordered list in which alarms shall be sorted first by priority and then chronologically. The newest, highest priority alarms shall be at the head of the list, which includes the alarm date, time, mnemonic code, point description and logging text. All alarm summary displays are filtered by the user's area or responsibility, and may be further filtered by alarm category and the disturbance mode threshold. Alarm summary displays are dynamic; the number of display pages varies from one up to as many as required to hold all the entries.

Available **Alarms Summaries** shall be:

- **Alarm Summary**, which shall display complete list of alarms,
- **Alarm Limits Summary**, which shall show all alarm limits in RTDB,
- **Acknowledged Alarm Summary**, which shall display a list of all acknowledged alarms in the system,
- **Alarm Overrides Summary**, which shall contain a list of all alarm limit overrides in RTDB,
- **Alarm Limits Set Summary**, which shall show all alarm limits set in RTDB,
- **Alarm Notification User Summary**, which shall show the list of all configured alarm notification users with their configured information,
- **Alarm Notification User Group Summary**, which shall show the list of all configured alarm notification user groups with their configured information,
- **Device Alarm Summary**, which shall list the alarms related to the selected device.

6. Hardware Requirements

6.1 Hardware requirements for DC, DCC, NOC & SOC

This section describes the technical requirements of all the hardware envisaged in the BOQ for the SCADA/DMS system including RTUs and IED, DOC, SOC, NOC and DCC. The minimum hardware configuration (RAM, Aux. Memory, interfaces) for various equipment is also specified here. The Bidder shall asses the adequacy of hardware specified in the BOQ & if any additional hardware or higher end hardware configurations are required to meet all the requirements of the technical specifications, the same shall be included in the offer. The Bidder's proposal shall include necessary calculations to clearly establish that the proposed hardware meets the functional and performance requirements of the technical specification.

The bidders are encouraged to optimize the requirement of hardware for servers/processors where one or more applications can be combined or distributed in any combination with adequate redundancy. However certain servers are specified to be hosted on independent hardware.

6.1.1 Overview

Wei intent to have workstation consoles for Operators at the control room who will be looking overall status and the monitor the field. Different servers have their application on them for functions. The GPS is used to maintain constant time in all the devices. A storage server which database is used to store all the usable data for future studies and planning application. All the data come from the field through a communication device.

6.1.2 Technical Requirements for Hardware

All hardware shall be manufactured, fabricated, assembled, finished, and documented with workmanship of the highest production quality and shall conform to all applicable quality control standards of the original manufacturer and the Contractor. All hardware components shall be new and suitable for the purposes specified. All hardware shall be of reputed make.

The contractor should ensure that at the time of final approval of hardware configuration/BOQ, all the above hardware is current industry standard models and that the equipment manufacturer has not established a date for termination of its production. Any hardware changes proposed after contract agreement shall be subject to the following: -

a) Such changes/updates shall be proposed and approval obtained from Employer along with the approval of Drawings/documents.
b) The proposed equipment shall be equivalent or with better features than the equipment included in the Contract.
c) Complete justification along with a comparative statement showing the original and the proposed hardware features/parameters including brochures shall be submitted to the Employer for review and approval.
d) Changes/updates proposed will be at no additional cost to the Employer.

6.1.3 Hardware Configuration

In this technical specification all hardware has been broadly classified as “Server” and “Peripheral device”. The term “server” (also referred as “processor”) is defined as any general-purpose computing facility used for hosting various application functions as defined in the specification. The servers typically serve as the centralized source of data, displays and reports. The term “Peripheral Device” is used for all equipment other than servers.

Peripheral device includes Workstation consoles, WAN router, LAN, printer, Time & Frequency system, External Cartridge LTO drive etc.

The redundant hardware such as Servers, Processors, LAN shall work in hot standby manner. All Servers, Processors and Workstation consoles shall include self-diagnostic features.

6.1.4 Servers/Processors

Each server shall have dual AC power supply which shall be fed from two different UPS sources. The servers shall be fully operational even when only one of the AC power supply is available. There shall not be any interruptions in the operation of the server when there is a failover between the two AC power supplies of the server.

The Servers shall have provision for expansion of the Processor, auxiliary memory and Main memory (RAM) of the servers by 100% of the delivered capacity. This expandability shall be possible at site with addition of plug in modules only.

Servers/processors are divided into the following types:

6.1.5 Application Servers (for SCADA/DMS & ISR):

- SCADA/DMS
- ISR
- Web server

SCADA/DMS application servers (also referred as hosts) and ISR servers shall be used to execute a variety of applications envisaged in the technical specification. They typically serve as the centralized source of database, display, and report definitions and most of the applications/programs shall reside and be executed on these servers.

The minimum hardware configuration of the application servers shall be as per **Annexure-1**

6.1.6 Communication Servers:

- Front –End server (Communication Front End) FEP(CFE)
- ICCP /Inter control center communication server

ICCP servers:

Communication Servers for ICCP applications (also referred as ICCP servers) shall be used to retrieve, transmit and process data to and from remote sources i.e. other control center computer systems. Data retrieved and processed from remote sources may be stored in communication Servers, which then distributes the data to other servers periodically or on demand.

The minimum hardware configuration of the ICCP servers shall be **Annexure-1**

Communication front end (CFE)

The CFEs offloads the task of communicating to FRTUs from the SCADA/DMS servers. FRTUs are connected to CFE through different communication medium via interface board. The interfacing hardware such as splitters, modems etc. shall also be housed in the CFE cubicle. CFEs shall have a suitable interface for time synchronization from the GPS based time synchronizing system. This interface shall have the time synchronization accuracy requirements consistent with the SOE time stamp resolution and accuracy requirements. The CFE shall further synchronize the time of all the FRTUs.

FRTU communication with AMR over DLMS (Device Language Message specification): The CFE shall have sufficient number of V.24/V.28 interface boards for communicating with the FRTUs on DLMS protocol. The number of V.24/V.28 ports in each CFE shall be adequate to integrate the specified no. of FRTUs and shall have 200% spare ports for connecting future FRTUs.

The CFE shall support FRTU communications by interfacing with the FRTU over various media such as power line carrier, leased line, fiber optic cable, VSAT and microwave link. Employer will provide the equivalent of unconditioned, voice-grade, type 3002, two or four-wire, point to point or party-line (Multidrop) communication channels between the master station and FRTU sites.

Each critical FRTU is provided with redundant communication channel between FRTU and CFEs whereas a non-critical will have a non-redundant (single) communication channel. Each Non-critical FRTU shall be connected to both the CFEs through a splitter whereas the Critical FRTU shall be directly connected to both the CFEs (i.e. one communication channel to one CFE and other channel to the second CFE without use of any splitter).

FRTU communication over IEC 60870-5-104: The CFE shall be provided with suitable interfaces for communication with the FRTUs over IEC 60870-5-104 protocol.

The minimum hardware configuration of the CFE servers shall be **Annexure-1**

Web server

The minimum hardware configuration of each web server shall be in **Annexure-1**

6.1.7 Firewall

The minimum hardware configuration of firewall shall be in **Annexure-1**

Intrusion Detection/prevention System

The contractor shall provide a tightly integrated intrusion detection system to detect and prevent intrusion. Definition updates for virus/signatures/software patches shall be done up to AMC period.

The features of each of the HIDS/NIPS are described below:

Intrusion Detection System (Host Based)

Host based IDS module shall be provided for the web servers. After detecting any intrusion attempt there should be provision to configure the IDS to perform following actions

- Send an SNMP Trap datagram to the management console.
- Send an event to the event log
- Send e-mail to an administrator to notify of the attack

Create an audit trail for user and file access activity, including file accesses, changes to file permissions, attempts to install new executables and/or attempts to access privileged services

In an event where user accounts are added, deleted, or modified, changes to key system files and executables is done in by unauthorized account or there is an authorized attempt to overwrite vital system files, to install Trojan horses or backdoors suitable action should be taken such as:

- Terminate User (intruder) Login
- Disable User (intruder) Account
- Forge a TCP FIN packet to force intruder connection to terminate

Capability for Detecting the intrusion attempt that may take place, intrusion in progress and the intrusion that has taken place.

Should provide events check for suspicious file transfers, denied login attempts, physical messages (like an Ethernet interface set to promiscuous mode) and system reboots.

Intrusion Prevention System (Network Based)

The NIPS shall provide complete inline protection from network-based application layer threats by scanning packet payloads for malicious traffic. It shall detect, classify and stop malicious application, viruses, worms and spyware/adware.

After detecting an intrusion attempt there should be provision to configure the IDS to perform following actions:

- Reconfigure the firewalls provided in this package
- Send an SNMP Trap datagram to the management console.
- Send an event to the event log.
- Send e-mail to an administrator to notify of the attack.
- Save the attack information (timestamp, intruder IP address, victim IP address/port, protocol information)
- Forge a TCP FIN packet to force intruder connection to terminate.
- 100 Mbps Ethernet Interface shall be provided.

In case, servers provided are of rack-mounted type, as an alternate to providing individual Cartridge LTO drive with each server i.e. application & ICCP communication servers, a centralized archival system consisting of an archive server with a tape autoloader (at least 6 slots and at least 2 tape drives) can be provided. This Archival system shall be used for taking backup of data from hard disks onto the LTO drives and for restoration of servers. The LTO Drives media used by the different tape storage shall be compatible and interchangeable.

Further the servers which are mounted in a rack (panel) may be provided with a common monitor (TFT), keyboard and mouse using a KVM switch. However, the grouping of servers in a rack shall be such that the primary and backup servers for a system function are located preferably in different racks/panels.

6.1.8 Workstation Consoles

Workstation console shall consist of a workstation driving one or more monitors, a single keyboard and a cursor positioning device/mouse. The user shall be able to switch the keyboard and cursor- positioning device, as a unit, among all the monitors at a console via push buttons or other controls.

One workstation console is envisaged to be used as Development system for taking up developmental activities like database, displays & reports development. Source code of SCADA/DMS applications, compilers & source code management utilities shall also be stored on this machine for taking up application code modifications & developmental activities. The bidder shall assess the suitability of workstation console for these requirements & if required higher end machines and/or additional servers may be included in the offer.

Workstation consoles shall be used by the dispatchers for control, monitoring and operation of power system. All workstation consoles shall support full-graphic displays.

The minimum hardware configuration of workstation console shall be **Annexure-1**

6.1.9 TFT Colour Monitors

TFT color monitors used for servers, workstation consoles shall have the following minimum
The minimum hardware configuration of monitor shall be as per **Annexure-1**

6.1.10 Remote Console

The remote console shall be connected to web server through WAN routers. Remote console shall be provided with web browser application. The minimum hardware configuration of remote console shall be as per **Annexure-1**

6.1.11 Local Area Network (LAN) switches

Servers and peripheral devices are connected to each other on a local area network (LAN), which allows sharing of resources without requiring any physical disconnections & reconnections of communication cable. Dual LAN is envisaged for the SCADA/DMSEMS system and for the Web Server.

Each LAN shall have characteristic as per **Annexure-1**

6.1.12 LTO drive

It is also known as Linear tape open Drive (LTO) and the specification are mentions as per the Annexure 1. Shall incorporate new storage device external hard disk with image back up software.

6.1.13 Laptop

The laptop shall have one LAN interface. It shall be primarily used for configuration of LAN, routers, modems etc. No separate furniture is required for the Laptop. Minimum configuration of the Laptop shall be as per **Annexure-1**

6.1.14 Printers

All printers shall be interfaced with Ethernet LAN either directly or through individual print server. Except for output capabilities unique to any printer type (such as extended character sets or graphic print capabilities), there shall be no limitations on the use of any printer to perform the functions of any other printer.

The different type of printers is defined below:

a) B/W Laser printer
b) Color inkjet printer

All Printers shall have minimum configuration as per **Annexure-1**

6.1.15 Videowall System

The contractor shall provide a videowall system based on modular LED technology. All the screen modules of the VPS system shall be suitable to form combined high-resolution projection images. The videowall system will be used to project displays of SCADA/DMS system independently of workstation console monitors. All the operations envisaged from workstation console (dispatcher) shall be possible from videowall also.

The Contractor shall supply all necessary hardware and software, including modesty panel, multi- screen drivers, adapters and memory to seamlessly integrate the video projection system with the user interface requirements described in the specification.

The videowall systems shall be 4K laser solution and shall be complete with all projection modules, supporting structures and cabling.

Design & installation of the video projection systems shall be coordinated with the Employer during project implementation.The requirement for each modular video display is as per the **Annexure-1**

6.1.16 GPS based Time Facility

One GPS controlling all the device. GPS based time facility to determine Universal Coordinated Time (UTC) source, shall be provided for control center computer system. The time receiver shall include propagation delay compensation and shall also include an offset to permit correction to local time.

The time receiver shall detect the loss of signal from the UTC source. A loss-of-signal shall be sent to the computer systems and used as a telemetry failure indication and result in an alarm in the SCADA system. Upon loss of signal, the time facility shall revert to an internal time base. The internal time base shall have minimum stability of 2ppm. Within five minutes of reacquisition of signal, the time shall return t -second of UTC. o within 1.5 micro

The GPS system receiver unit shall have digital display for viewing UTC day of the year and time in the format DDD: HH:MM: SS where the hour display shall be in 00 to 23-hour format and date in MM: DD: YY format.

GPS system shall also be used to drive Contractor-supplied time and day indicators suitable for panel

/ Wall mounting. The display for time shall be in the 24-hour, HH:MM: SS format. The display for the day shall be XXX format (MON through SUN).

The display for frequency shall be in the XX.XX Hz format. The frequency display shall have suitable interface with the SCADA system such that any selected power system frequency measure in the SCADA system can be assigned to it.

Each digit of all the indicators shall be at least 7.5 cm in height and shall be bright enough.

All required interface in this regard shall be included in the scope of supply as per **Annexure-1**.

6.1.17 Auxiliary Power Supply for Control Centre equipment

The computer system should be suitable for operation with single-phase, 230 +10% Vac, 50 +5% Hz power supply. The UPS system being purchased under this Contract comprises of redundant UPS operating in parallel and shall be used to ensure uninterrupted & regulated power supply to the computer systems. The Contractor shall provide additional fuses, switches and surge protection, if necessary to protect the computer system hardware.

In case of low battery capacity condition in the UPS, the computer system shall undergo an orderly shutdown to avoid corruption of any software applications & damage to computer hardware. The contractor shall use the automatic orderly shutdown application' of UPS manufacturer for initiating orderly shutdown of the computer system.

6.1.18 Acoustic Noise Level

The noise level of any equipment located in the computer room shall not exceed 60 dbA measurements at three feet from the enclosure. The noise level of equipment located outside the computer room shall not exceed 50 dbas three feet from the enclosure. Sound-deadening enclosures shall be provided where necessary to meet these requirements.

6.1.19 General Construction Requirements

The enclosures/panels, used for mounting or placement of equipment, shall be constructed in accordance with the following requirements.

6.1.20 Panels

In case the equipment is mounted in panel type of enclosures, then such enclosures shall meet the following requirements:

- The enclosures shall be finished inside and out. All cabinet metal shall be thoroughly cleaned and sanded, and welds chipped to obtain a clean, smooth finish. All surfaces shall be treated to resist rust and to form a bond between the metal and the paint.
  Enclosures (except for server racks) shall confirm to IP31 degree of protection. All the louvers shall be provided with suitable wire mesh.
- Enclosures shall be floor mounted with front and rear access to hardware and wiring.
- Moving assemblies within the enclosure, such as swing frames or extension slides, shall be designed such that full movement of the assembly is possible without bending or distortion of the enclosure or the moving assembly.
- Enclosures shall not require fastening to the floor to preclude tipping of the enclosure when the moving assembly is extended.
- Cable entry shall be through the bottom. No cables shall be visible, all cables shall be properly clamped, and all entries shall be properly sealed to prevent access by rodents.
- Cooling air shall be drawn from the conditioned air within the room. Ducted or directed cooling air to the enclosures will not be supplied by Employer.
- All wiring shall use copper conductors. Conductors in multi core cables shall be individually color coded.
- Wiring within the enclosures shall be neatly arranged and securely fastened to the enclosure by non-conductive fasteners. Wiring between all stationary and moveable components, such as wiring across hinges or to components mounted on extension slides, shall allow for full movement of the component without binding or chafing of the wire.
- All materials used in the enclosures including cable insulation or sheathing, wire troughs, terminal blocks, and enclosure trim shall be made of flame retardant material and shall not produce toxic gasses under fire conditions.
- All enclosures shall be provided with suitable internal lighting lamp, 230 VAC 15/5A duplex type power socket & switch for maintenance purpose.
- The finish colors of all enclosures/panels shall be finalized during detailed engineering.

6.1.21 Enclosure Grounding

A safety ground in accordance with Bhutanese standards shall be provided within each enclosure and shall connect to the ground (green) wire of the ac power input.

Where field signals are terminated within an enclosure, a signal ground, isolated from the safety ground, shall be provided. The signal ground shall terminate at a stud connection sized for a lugged 2/0 ground wire. Use of the enclosure frame, skins, or chassis-mounting hardware for the signal ground is not acceptable. The signal ground shall be connected to communication equipment signal ground using cable shields.

6.1.22 Interconnections

All signal cabling between component units of the computer systems shall be supplied by the Contractor. Plug-type connectors with captive fasteners shall be used for all signal interconnections. The connectors shall be polarized to prevent improper assembly. Both ends of each interconnection cable shall be marked with the cable number and the identifying number and location of each of the cable's terminations. Each cable shall be continuous between components; no intermediate splices or connectors shall be used. Terminations shall be entirely within the enclosure.

7. Design Parameters and Performance Tables

The SCADA/DMS system shall be designed as per the technical parameters defined in the specification and the tables specified here. The SCADA/DMS system (such as databases, network elements etc.) shall be sized to accommodate the requirement mentioned in table 7. The system shall be tested with the doubled present power system size (ultimate capacity) as defined in table 7 & measure the various performance of the system as defined in the tables and technical specification including peak and average load scenarios. The auxiliary memory utilization, average CPU, RAM & LAN utilization parameters shall not exceed the limits as defined in table 8. This memory utilization includes the memory used for storage of data for the defined duration as specified in the various sections of technical specification. The SCADA/DMS system shall be suitable for addition of at least double the operator workstations (in future) without requiring any up gradation of the servers. The SCADA/DMS system design & performance parameters are defined in the following tables:

7.1 TABLE 1 - Design Parameters For Scada Functions

Sl.No.	Function Description	Design capacity	Execution rate
1	Data Acquisition from	As per specification	
	a) Status data	All status points	By exception, updated & displayed within 4 secs from data collection from RTU at S/s
			6 secs from data collection from FRTU/ FPI
			Integrity check of all status at every 10 Minutes (configurable)
			On demand
	b) Analog data	All analog points	For analog data the time skew shall not be more than 1sec & latency shall not be more than 1sec for analog as per IEEE C37.1.
			Integrity check for all analog at every 10 Minutes (configurable)
			Provision for all analog update at periodicity of 10 sec configurable up to 1 hour.
			Energy values periodically configurable from 5 min to 24 hours
			· Energy values of 15-minute blocks shall be collected periodically from the RTU, FRTU at scan rate of 15 minute/1 hour (configurable up to 24 hours). Alternatively, the energy values shall be calculated for each 15 minute/1-hour blocks at SCADA level from the acquired energy values of MFTs through RTU & FRTU.

Sl.No.	Function Description	Design capacity	Execution rate
			The time skew at SCADA/DMS control center, S/S, RMU, FPI shall not be more than 0.1sec at each location & latency shall not be more than 0.5sec for status. For analog data, the time skew shall not be more than 1sec & latency shall not be more than 1sec for analog as per IEEE C37.1.
			On Demand
2	Time synchronization of RTU	All RTUs shall be synchronized from Master station	every 5 Minutes (Configurable from 5-60 minutes)
3	SCADA/DMS Data Exchange with other system as specified	As per specification	A/R for ISR function & data exchange
4	Data Processing		
4.1	Analog data		
	a) Conversion to engineering units	Per analog points	Each time the value is received in SCADA
	b) Zero dead band processing	Per analog points	Each time the value is received in SCADA
	c)Reasonability Limit checking	High and Low reasonability limits per analog point	Each time the value is received in SCADA
	d)Limit monitoring (Operational, Alarm and Emergency limits)	High and Low for each of the limits per analog point	Each time the value is received in SCADA
	e) RATE OF CHANGE	per analog point	Each time the value is received in SCADA
	f) Sign conventions	per analog point	Each time the value is received in SCADA
	g) Accumulator processing	per analog point	Each time the value is received in SCADA
4.2	Calculated Data		
	- Arguments for analog calculations	32	Each time the value is received in SCADA
	- Arguments for status calculations	32	Each time the value is received in SCADA

Sl.No.	Function Description	Design capacity	Execution rate
	- No. of calculated data (Min / Max with time stamp and Average)	3 X no. of analog point for max /min/age and 1x no. of max/min/age for other calculations	Min/Max /Average calculation for each 5-min duration
4.3	Digital Input data	As per specification	As per specification
4.4	Substation Topology Processing	For no. of status, refer RTU/FRTU/FPI point counts in the technical	Triggered by status change.
4.5	Alternate source of data	For all status, analog	Each time the value is received in SCADA
4.6	Quality codes	As per specification	Each time value is received by SCADA
5	Continuous Real-time data storage & Playback	a) At least 2 days storage for all tele-measured	a) Each time the value is received from RTU in SCADA database
		b) Playback of stored data for selected time of 1 to 10 minutes	b) playback sampling rate configurable in Second/ minutes
6	Sequence-of- Events data	1000 events circular buffer in the SCADA	SOE retrieval Periodically (5 minutes) or by exception and on demand
7	Supervisory Control		
	a) Control Inhibit Tag Types	4	(a) (b) (c) On demand by Dispatcher/DMS function initiated
	b) Control inhibit Tags Per Device	4	(d) Each time supervisory control is requested
	c) Control Action Monitor	10 timer periods (1 to 60 sec)	
	d) Control permissive	For all control points	
8	Fail-soft capability	Critical functions	in the event of system crosses mark of peak loading requirements through graceful de-gradation of non –critical functions & also relaxing periodicity / update rate of display refresh & critical functions by 50%.

7.2 TABLE 2 - Design Parameters For Isr Functions

Sl.No.	Function Description	Design capacity	Execution rate	Response time
1	Circuit breaker status table	Data as per spec for all CBs	Updation on change in CB status or any of the associated information	2 secs after updation in SCADA database
		b) data storage On Auxiliary memory	b) 2 months retention	
2	Data Snapshot table	a) Volume of data = Total telemetered status and analog points and max/min with time stamp and average for each analog point with quality codes	a) Snapshot - 5 minutes periodicity	
		b) data storage On Auxiliary memory	b) 2 months retention	
3	Data Exchange (with Customer Care System (CCS) as applicable)	Circuit breaker status table	By exception & On demand by CCS	30 secs
4	Hourly data table	a) Volume of data = Total telemetered points and max/min with time stamp and average for each analog point with quality code	a) Hourly	
		b) data storage On Auxiliary memory	b) 2 months retention	
	Hourly Energy data table/Missed hourly data table	a) Volume of data = Export/Import KWh & Export/Import KVARh for all energy meters with quality code	a) Energy values of 15-minute blocks of each Hour	
		b) data storage On Auxiliary memory	b) 2 months retention	
	Daily Energy data table	a) Volume of data = Export/Import KWh & Export/Import KVARh for all energy meters with quality code	a) Energy values of 15-minute blocks of each Hour	
		b) data storage on Auxiliary memory	b) 2 months retention	

Sl.No.	Function Description	Design capacity	Execution rate	Response time
	Load priority table	Data as per spec for all CBs	On demand. Besides load priority shall be possible to assign locally in SCADA/DMS system.	
	SOE data table	daily 4 changes per SOE point	Each time the SOE is received from RTU/FRTU/FPI in SCADA database	
5	Data exchange (with Billing system as applicable)	a) Daily Energy values of specified hour	a) Daily & on demand	a) 30 secs
		b) Load priority table	b) On demand by SCADA or change in priorities by Billing system	

Sl.No.	Function Description	Design capacity	Execution rate	Response time
1	Data Exchange with GIS System	Data of electrical network	On user request/validation	
2	Historical information data retrieval	Retrieval of all stored data	On demand	
3	System message Log Storage	a) 20,000 entries /month		
		b) data storage On Auxiliary memory	b) 2 months retention	
4	Mass storage of data file	As per spec		

Sl.No.	Function Description	Design capacity	Execution rate	Response time
5	DR function	As per spec	As per spec	
DATA EXCHANGE REQUIREMENTS WITH NLDC SHALL BE DEFINED BY UTILITY AS PER EXISTING SLDC SYSTEM CONDITIONS				

7.3 TABLE 3 - Design Parameters For Dms Functions

Sl.No.	Name	Design capacity	Execution rate	Response time
1	NETWORK MODEL	One model with at least 10 possible islands. Islands may be formed dynamically. All electrical components mentioned in the spec		
2	NETWORK CONNECTIVITY ANALYSIS (NCA)	Complete network		
	2) Real time mode		Event driven	2sec
	b) Study mode		On demand	2sec
3	State estimation	Complete network	On change	Complete network
4	LOAD FLOW APPLICATION (LFA)	Complete network		
	a) Real time mode		- periodic (10 minutes) - On demand by user / application - Event driven	5sec
	b) Study mode		On demand	5 secs
5	Voltage/VAR Control	All tap changers & cap bank	On change	5sec
6	LOAD SHED APPLICATION (LSA)	Complete network		
	a) Manual mode		a) On demand	a) 30sec (for analysis)
	b) Auto mode		b1) On scheduled time (Time of day) b2) Event driven (Frequency threshold)	b) 30 secs (for analysis)

7	FAULT MANAGEMENT & SYSTEM RESTORATION (FMSR)	At least two simultaneous faults in the network shall be supported & Complete network		
	Manual mode		On demand	
	Auto mode Generation of switching plans		Event driven	
	Prefault configuration mode		On demand	
8	LOSS MINIMISATION VIA FEEDER RECONFIGURATION Generation of switching plans (Manual & Auto mode)	Complete network	-Periodic (15 minutes) -On demand	30 secs
9	LOAD BALANCING VIA FEEDER RECONFIGURATION Generation of switching plans Manual & Auto mode	Complete network	-Event driven - periodic (15 minutes)	30sec
10	Distribution Load Forecasting	Complete network	Periodic & on demand	30 secs
11	Operations Monitor	Complete network	change in devices status	5 secs
12	DTS	Complete Network	Replica of SCADA/DMS	Same response

7.4 TABLE 4 - Maintenance Activities

Action	**Performance**
Complete database regeneration	2 hours
Complete system software build, including operating system, applications, and databases	6 hours
Software build or all applications and databases	3 hours
Software build of a single applications and databases	10 minutes
Installation of a single, new display including distribution to all consoles	60 seconds
Reinstallation of all displays	60 minutes
Perform an on-line update of a database parameter and propagation of the change to the source data	60 seconds

7.5 TABLE 5- Design Parameters For User Interface

Sl.No.	**Name**	**Design capacity**	**Execution rate**
1	**SCADA/EMS SYSTEM ACCESS SECURITY** Function and Data Access Security Operating jurisdictions	16	
2	**Windows Environment**		

Sl.No.	Name	Design capacity	Execution rate
	Rooms	32	
	Layers	8	
	Declutter Levels	16	
	Panning and Zooming	supported	
3	**TREND**		
	a) Trend files	10	
	b) Variables per trend file	4	
	c) Samples per trend variable	5,000	
	d) Sampling rate	Configurable from 5 secs to 15 minutes	
4	**ALARMS**		Triggered by event
	Alarm priority levels	16	
	Alarm Message Recording on auxiliary memory - alarms	2months	
5	**EVENTS** Event Message Recording on Auxiliary memory - events	2months	

7.6 TABLE 6 - Configuration Characteristics & Availability Functions

Sl.No.	Name	Execution Rate	Maximum Response Time (With in)
1	CONFIGURATION CHARACTERISTICS AND AVAILABILITY Backup Databases Data backup	60 seconds or event driven	4 seconds

Sl.No.	Name	Execution Rate	Maximum Response Time (With in)
2	Processor Errors Processor failure detection Device Errors Device failure detection		10 seconds 10 seconds
3	Processor Redundancy and Configuration Management Function Restart Other functions except ISR		30 seconds 120 seconds
4	Processor Start-Up *with applications functional* 1) Hot Start 2) Warm Start a) all applications 3) Cold Start a) Application except ISR operational b) ISR application		1) Not more than failover time 2) 10 minutes a) 15 minutes 3) 15 minutes a) 20 Minutes b) 60 Minutes
6	Device/Processor Failover		30 seconds from detection of failure.
7	**Main & Backup Control Centre**		
	Real-time data Update	10 secs	2 secs
	Integrity scan	10 mins	
	Monitoring of each other's facility	2 mins	2 secs

7.7 TABLE 7- Performance Requirements And Activities For Normal And Peak Level Of Loading

At no time the SCADA/DMS system shall delay the acceptance of User request or lockout console operations due to the processing of application functions.

User interface requirements	Response time (Peak loading)
Requests for call-up of displays shall be acknowledged with an indication of request is being processed	Within 2 secs
Any real-time display and application display (except RDBMS DB displays) on workstation console, Complete display & data values shall appear on screen	Within 3 secs after acknowledgement of request
Manual Data entry of the new value shall appear on screen	Within 2 secs
Display update rate	Every 2 secs for at least 4 displays together
Panning of a world display from one end of screen to other end of screen in a continuous manner	Within 2sec

User interface requirements	Response time (Peak loading)
Supervisory control action shall be completed with result displayed on the screen	Within (2sec + scan time + communication delay time +field device operation time)
Alarm and event response time	display within 1 sec of receipt in SCADA/DMS system
Alarm and event acknowledgement	Within 2 secs
Requests for printing of displays shall be acknowledged with an indication of request is being processed	Within 2 secs
Requests for generation of reports shall be acknowledged with an indication of request is being processed	Within 2 secs

7.7.1 UTILISATION (Considering double the present power system size)

Name	Average Utilization	Comments
PROCESSOR UTILIZATION		
Servers Communication Front end ICCP server	30%	Normal loading
	50%	Peak loading
	30%	Normal Loading
	67%	Peak loading
LOCAL AREA NETWORKS		
Uncontrolled Access (e.g., Ethernet)	15%	Normal loading
	20%	Peak loading
Controlled Access (e.g., token- ring)	40%	Normal loading
	40%	Peak loading
MEMORY		
Main memory utilization (age)	50%	Normal loading
	67%	Peak loading
Auxiliary memory utilization	50%	

7.7.2 Activities for Normal and Peak Level of Loading

Normal Level Activity

The normal level of activity shall simulate system activities spread over one-hour period. During the testing, the response times and the average utilizations shall not exceed the specified values. The following conditions define normal level of system activity to generate the normal loading scenario. Test simulation shall be done using software tool to generate this loading within 1 hr. Staggering of loads during the test duration of I hour is permitted.

a) All RTU/FRTU/FPI data shall be scanned and processed as specified in the Specification.
b) All data exchange with other systems shall occur as specified in the Specification.
c) All periodic functions shall be executed at the rates defined in tables
d) The following SCADA/DMS functions shall be executed on-demand:

Function	**Number of demand executions**
Substation topology processor	50 state changes
Sequence-of-Events data	50 SOE points reported
All DMS applications	4 on-demand per DMS application

e) Alarms (2 X no. of RTUs +FRTU+FPI) per hour shall be generated. Each alarm shall be acknowledged individually within 5 seconds.
f) Events (2 X no. of RTUs +FRTU+FPI) per hour shall be generated.
g) 1% analog of total analog/ 5sec measurements of total analog point count changes as per IEEEC37.
h) One complete run of on-line diagnostics shall be performed on all computers.
i) Communications channel monitoring shall be performed.
j) The following user interface actions shall be performed:

Display Selection	30 per operator workstation & VPS
Supervisory control actions	2 per RTU & 1 per 50 FRTUs
Display Updates	Each operator workstation shall display 3 updating and 1 non-updating display window per monitor. This also includes VPS. Updating displays: - alarm summary list - world display containing a S/S SLD - Network display Non-updating displays: - SCADA/DMS System Display
Data Entry	5 data entry actions from any single display
Display Trending	8 display trends, each trending 4 variables
Reports	Prepare and printing of 5 reports

The following maintenance activities shall be performed:

Function	**Task**
On-Line Database Editing	Modify 20 data points in each of the 5 RTUs
Display Generator Management	Modify one single-line diagram one tabular display

Peak Level Activity

The peak level of activity is an addition to the average level of activity described in Sub Section NORMAL LEVEL OF ACTIVITY above. The peak level of activity shall be applied for a five-minute period. During the

next ten minutes, only the normal level of system activity shall be applied. This test shall be repeated for four consecutive fifteen-minute periods, for a total peak level test time of one hour. The five-minute peak loading period shall coincide with SCADA/ DMS system period where all periodic software is scheduled for execution and at least one five-minute period shall span an hour boundary to consider the scheduled hourly periodic activities. There shall be no restrictions on the period when the five-minute peak can occur.

The software execution rates and response times defined in tables of this section, shall not be degraded and the utilization defined in tables of this section shall not exceed during the peak loading conditions. The following conditions shall define the additional peak level of system activity:

a) As per IEEE C37.1
    a. 15 % of status of total status points/ 5sec measurements
    b. 40% analog of total analog measurements /5sec
b) Display Requests
    a. 6 display requests
c) Supervisory control
    a. Total 1 per RTU & 1 per 10/ FRTUs in four 5Minute period of peak loading cycles
d) Reports
    a. Prepare 5 reports

8. Operation and Maintenance Services (O&M)

The SI shall be required to provide the services so as to manage entire SCADA/DMS system installed & commissioned by SI for NEA to realize their desired business objectives.

System Management Services shall be provided by SI in order that maximum uptime and SI levels of installed SCADA DMS systems is ensured. As such, SI is expected to provide services with SI levels meeting or exceeding those mentioned in the section Design Parameters and SI Tables.

The O&M shall start immediately after the completion implementation period and acceptance by the user. The O&M would, include following services:

8.1 SCADA/DMS-OMS

8.1.1 Operation

24*7 Operation of Distribution Control Centre

a) Control and monitor remotely all kind of field activities regarding telemetering
b) Provide remote assistance to field staff about sudden breakdowns/tripping.
c) Improve System Reliability and reduce Power Restoration Time.
d) Enable faster Identification of faults.
e) Minimize “Un-Served Energy”.
f) Facilitate Technical Loss reduction.
g) Improve Consumer Satisfaction Level.
h) Assistance for power scheduling and creation of various analytical reports.
i) Carry out call center support activities from the control room.
j) Load forecasting, load scheduling and load shedding, Load Management, system monitoring and control.
k) System Monitoring and Control
l) Distribution shutdown (Planned & Emergency) & Notification approval (BY USING PTW GUIDELINES)
m) Integration with Transmission Points and other areas in the utility
n) Ensuring Safety of working person and equipment during real-time operation
o) Network correction in SCADA/DMS system
p) Operational co-ordination with transmission, exchange point data and other co-ordination with utility personal for operation and load management activity.
q) Coordination for System Alteration
r) Calculation of reliability indices such as SAIDI and SAIFI
s) Alarm Management, Outage Management

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 SCADA/DMS systems
b) Operation training of SCADA enabling component like RMU, Sectionalizer and auto recloser
c) Training for protection co-ordination

8.1.2 Maintenance

The maintenance of the SCADA-DMS 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
c) Services to bring up any or all SCADA-DMS systems upon its failure and to restore the functioning of SCADA-DMS system including Control Centre etc.
d) Database sizing and CFE card addition for new RTUs/FRTUs
e) The support for the RTU's /FRTUs and IEDs
f) All Software modules under the SCADA-DMS System and the associated Hardware supplied under this project.
g) Routine works like database building, addition of analog and status points and other such day-to-day operational activity would primarily be the responsibility of Utility and in case of any difficulty in this regard the same shall be referred to the SI for support.

Hours of Cover

The SI's on-site support standard hours of service, the timings for Emergency Software Support would be 24 hours a day, 7 days a week throughout the year (i.e. 24x365). At least three Engineers including Site Manager along with one on-site support personnel for Hardware and one on-site personnel for Software shall be deployed at DCC. The support personnel so deployed shall be qualified personnel having experience in the delivered SCADA/DMS system.

The SI shall be responsible for 24*7*365 management of all the systems as per scope of work with services rendered at least as per Service Level Agreement between NEA & SI. The Scope does not include management of physical security for access to the said facilities. The following facilities will be provided at the start of contract to SI by NEA for carrying out the O&M responsibilities:

a) Appropriately secured lockable storage/setup area
b) Sufficient Sitting/office space in neat & clean environment
c) PC (other communication facilities like P&T telephone & internet facility are to be arranged by SI)

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.

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, 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 desktop machines/workstations, servers, peripheral equipment, and network-attached peripheral equipment, which form part of the existing SCADA/DMS System (new equipment needs to be procured by the Utility).

Move: Movement of desktop machines/workstations, servers, peripheral equipment, and network- attached peripheral equipment.

Add: Installation of additional hardware /software after initial delivery

Change: Upgrade to or modification of 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

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) Analyse 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. Since during initial three two years, warranty is in scope of bidder there will be no AMC for SCADA/DMS system. During such period, SI has to interact with such vendors for maintenance services and spares. After warranty period, if required Utility can award the suitable AMC and SI has to interact with vendors as selected by utility for providing AMC for the said system based on the process quoted in the proposal against the AMC line item.

Backup and Restore Management

SI will perform backup and restore management and shall ensure:

a) Backup and restore of data in accordance to defined process / procedure.
b) 24 x 7 support for database 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 etc.,
o) Interacting with Process Owners in developing / maintaining Backup & Restoration Policies / Procedures
p) To provide MIS reports as per agreement

Restoration of Control Centre in case of failure

The SI shall ensure that all the relevant data is transferred from control centre at regular frequency to Data Recovery Centre (DR)(details will be provided by NEA) which is required for restoration of Distribution Control Centre in case of complete failure of Control centre.

The SI shall carry out system build in order to build the SCADA/DMS system at Control centre from scratch utilizing DR Centre.

Performance Monitoring and Reporting

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, Central Storage etc. Regular analysis of events and logs generated in all the sub systems including but not limited to servers, operating systems, databases, applications etc. The system administrators shall also ensure that the logs are backed up and truncated at regular intervals.

The administrators shall undertake actions in accordance with the results of the log analysis to ensure that the bottlenecks in the infrastructure are identified and fine-tuning is done for optimal performance.

Reporting to utility for all system performance monitoring.

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 equipments 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 equipments such that higher levels of performance of the resources are obtained.

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:

Support Services

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 team comprise of experienced technical staff that are skilled in troubleshooting SCADA / DMS systems. Severity 1 problems shall be reported by telephone for rapid response; target response times are defined in clause 0. The SI shall submit the process details to meet the above requirements along with the offer. For severity 1 problems, the key objective is to restore the system to an operational state as quickly as possible, including by a temporary workaround. Resolution of the defect may be completed during standard hours. 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.

Monitoring

The SI shall conduct the following monitoring, for the supplied SCADA/DMS System.

8.1.2.1.1.1 Error Log Monitoring

To monitor the SI of SCADA/DMS system on a bi-weekly basis, the SI shall review the following, analyse the results, and communicate to Utility:

a) System logs for a selected day
b) System history log
c) Aggregate data collection
d) Events Collection

During monitoring if any defect is found, the SI shall undertake corrective action for the same. The SI shall submit the process details to meet the above along with the offer.

8.1.2.1.1.2 Resource Monitoring

Resource Monitoring services comprises checking the system's major node resources, gather log data, analyse results, and advise Utility on the appropriate actions to be taken and undertake any agreed upon actions. A tool will be created to continuously collect the following information:

- CPU loading (Peak and Average)
- System error log
- Disk utilization (Peak and Average)
- Operating system error reports
- LAN utilization (Peak and Average)
- Bandwidth utilisation
- Memory utilisation (Peak and Average)

The SI shall submit the procedures details to meet the above along with the offer.

Support for System Expansion

New RTUs, RMUs & FPIs etc per year are likely to be added to match the growing Power system. The services to be provided by the SI will include the Communication Front End (CFE) port/card addition/expansion, database resizing, interface addition in CFE and support for integration confirming to the IEC standards / existing application. This would not include the cost of equipments/card required for expansion.

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 Man-power at DC, DCC,NOC, SOC 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.

The details of the system under different severity level are as below:-

Severity of the system under different Severity level.

a) Severity-1 (Urgent support)

This support is required when there is a complete system failure, severe system instability, the loss/ failure of any major sub-system / system or its components, which may significantly impact the system availability, SI, or operational capability at DC, DCC or field. For example, loss of data to the operator due to any problem in SCADA-DMS system, loss of ICCP system (software/Hardware related),Loss/failure of DR Centre, outages of both the CFEs attributable to any software/hardware related problem, outage of any important software functionality (on both the servers) which is required to disperse Distribution management functions, , Failure of both GPS clock and time synchronization and outage of both routers, failure of both LAN system, outage of both main and backup servers of any system, firewall would be included under this category. The SI would immediately attend to the problem and if required, any other authorized representative the SI may log on to the system. The problem shall be attended by the SI at the earliest, within the response/Resolution time as specified in the Agreement. The SI shall take all steps to restore the SCADA system functionality at the earliest to avoid data loss.

b) Severity-2

The support services not defined under Severity-1 are included under this category**.** Failure of one SCADA/DMS/FEP Server/ICCP server, failure of VPS, Stoppage of data collections for archiving, real time calculations, failure in Acquisition of SOE at the respective Control-Centre, outage of Real Time Network and distribution applications, and other applications are included in this category. Coverage under this severity would be outages that do not immediately cause on feeder data loss but subsequently could result into Severity-1 category outage, loss of an important subsystem that may affect the day-to-day works and loss of archived data. Failure of any redundant system component affecting the critical redundancy like loss of any one Application Processor, Router, CFE would also be included in this category. Non-availability of Man-power at control centre during working hours will also be covered under this category.

c) Severity-3 (Standard support)

The support services included under this category are when the outage or loss of functionality is neither an emergency nor a priority functionality as indicated in severity level 1 or 2 above. Problems like database reworking, failure of any one workstation, etc. would be covered under this Severity.

d) Severity-4 (General Technical Help)

Request for information, technical configuration assistance, “how to” guidance, and enhancement requests are included under this category.

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 Resolution Time	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 (i.e. Hardware & Software supplied under the SCADA/DMS System), 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:

- Patch Management for OS and Application Software
- Automatic update of Antivirus and firewall signatures on daily basis.
- 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, CFE panels and RTUs/FRTUs 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.

SI's Obligation

- In order to optimise and improve the response of the system, the SI may re-install the program modules after making the Utility engineer aware of the consequence (like data loss, database rebuild etc).
- Any modification of software/Operating System required to restore functionality due to hardware upgrades, patches, or arising out of a necessity to fix FPRs, would be done by the SI at no extra cost to Utility. Also, any software updates/upgrades released till the completion of warranty period /AMC shall be provided and installed & commissioned free of cost as per instructions from Utility.
- 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.

Responsibility of Utility

- Utility will ensure the availability of competent staff appropriately trained in the administration and use of existing SCADA/DMS systems for proper operation of the system.
- 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.

8.2 RTU (RTU & Associated Cards, MFT/MFM and Other associated cabling)

8.2.1 Introduction

This consists of necessary measures to maintain the equipment in case a fault is reported to bring the equipment in proper operating condition. Comprehensive maintenance includes fault finding, repair or replacement of defective parts and functional checking in coordination with respective RTU reporting control centers .Break down Maintenance is to be carried out in the event of malfunctioning / non-reporting of RTUs / cards, which blocks the normal operation of the RTU.

Immediately on noticing the fault, the fault will be reported by the NEA/ Utility staff on phone/fax/e mail to the SI and the details will be informed as per approved format. The fault reporting time on phone shall be taken as reference time for the purpose of Response time (RT) and up time (UT).

8.2.2 Response Time

SI shall depute his engineer so as to reach site within 6 Hrs at faulty site. This RT is in case of RTU not reporting to control centre. The response time for other type of faults (Analog/Digital data not coming correct/Data validation) shall be 24 Hrs. Uptime/rectification time of the fault shall be 2 Hrs after access to the site.

8.2.3 FRTU Scope

1. Physical inspection of RTU
2. Tightening of all the power and control connections
3. Checking of earthing & recommendation to improve the same if required
4. Checking of DC Voltage
5. Checking for all Telemetered Parameters
6. Checking for AC Voltage L-L, L-N
7. Rectification of fault.
8. Repair & Replacement of Faulty Cards/Modules (CPU, PSU, AI, DI, DO, MFT, MODEM, etc.) as per requirement
9. Analysis report of the fault
10. Plan for preventive measure to arrest recurrence of such faults.
11. Checking /re-configuration of MODEM/s at RTU and control centre ends.
12. Downloading of database files and updating of new database in the RTU for additional bay integration work

Any activity carried out above shall be recorded for all the visits and activities carried out during AMC period shall be maintained by the SI and monthly report for all such activities shall be submitted to NEA in review meetings.

a) SI shall repair and replace faulty cards/modules (CPU, PSU, AI, DI, DO, MFT, MODEM, etc.) or equipment identified during the comprehensive maintenance. SI shall check MFT/MFMs/Transducer and CMR outputs for correctness of parameters being telemetered whenever the need arises.

b) SI shall document the maintenance activities carried out and shall establish a maintenance record for the SI of their duties and location wise history record of the equipment for future reference.
c) Monthly report should be submitted to NEA.
d) SIs services must be available on phone or fax round the clock on all working days/holidays for fault reporting and corrective actions. Emergency calls will be attended with utmost priority keeping aside any protocol and obligations.
e) SI shall use his own testing instruments/ tools/ any other item required for maintenance of equipment. If any special testing equipment/s is/are required for testing and repair of the system, same shall be arranged by the SI.
f) SI shall arrange any other materials, required to maintain the RTU which is not specifically mentioned in this scope.
g) Material for additional bay integration shall be provided to the SI by NEA for RTUs installed at various locations .
h) SI shall nominate a qualified and experienced Project Manager resident at Kathmandu/ Distribution Control Centre and other resources as per minimum indicative manpower requirement.This however, does not relieve SI for assessing their actual manpower requirement more than specified above, for rectification of fault within stipulated RT and UT. The Engineer I/C at Kathmandu/ Distribution Control Centre shall be solely responsible for coordination with all its service engineers available at various sites for rectification of faults. The Engineer I/C shall be adequately supported by technical staff for quick restoration of the system. Engineer I/C shall arrange for adequate transportation/accommodation for their staff as per work demand. All SI's staff should be equipped with necessary tools kit, testing instruments and mobile phones.
i) SI will take all due necessary safety precautions for proper safety of man & machine while carrying out the work at site. SI will also be required to take necessary insurance cover for the personnel deputed for the work covered under this contract. NEA shall have no responsibility whatsoever for claims arising out of negligence/accident or any other reason for the personnel employed by the SI.
j) SI will carry out quarterly (3 monthly) preventive maintenance visits at all RTU locations. The work during preventive maintenance includes following activities.

- Physical inspection of RTUs to check physical damage, cleanliness, rat droppings, lizard or other vermin and take corrective actions as required
- Checking up of environmental conditions and report any abnormality to customer for necessary corrective action by them.
- Preventive measures like blowing and cleaning for removal of dust from RTU panel, tightening of all power and signal connections in RTU/SIC panels.
- Checking MFT/MFM/CMR's output for any suspected/bad input values

8.2.4 NEA's/ Utility's Responsibility

a. NEA shall nominate an Engineer I/C who shall be sole coordinator and interface between NEA and the SI.
b. NEA shall arrange security passes/ permissions required by SI's maintenance engineers for all sites.
c. NEA shall ensure free and unrestricted access to equipment sites during the maintenance period to the vendor's personnel and /or authorized personnel working on behalf of SI.
d. NEA shall provide to the SI with the information on any planned expansion, alteration or relocation of the equipment that may have the impact on the system under maintenance.
e. NEA shall provide following information in the prescribed format as fault reporting procedure.
    i. Indication of LEDs in RTU panel (on the cards and modems)
    ii. Status of communication link
    iii. Healthiness of 48 V DC supply to the RTU panels
    iv. MCB positions in the RTU

On receipt of these information SI shall depute their personnel at site. Fault reporting time shall start after requisite information in duly filled up FORMAT is informed to the SI by fax/e-mail/phone. SI's engineer shall reach within 6 hours of fault reporting at fault site for the fault where RTU is not reporting to control centre and within 24 hours of reporting for other type of faults for eg. anomaly in analogue or digital values etc. SI's personnel shall restore the RTU reporting within 2 hours of reaching at site failing which penalty shall start and shall be applicable as per Section **Error! Reference source not found.**.

8.3 DC area and other area

The SI should consider the below manpower for operation and maintenance,

Sr.No	Operation and maintenance manpower	General	1st Shift	2nd Shift	3rd Shift
1	Data center 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 labour 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 datacenter.
2	Multi Skilled Technician	Diploma in Electrical/Electronics/Instrumentation/mechanical with 4 years of total experience with minimum 2 years of experience in managing physical infrastructure of datacenter

9. Service Level Agreements (SLA)

It is the endeavour of both the SI and Utility to maximize system availability to the extent possible. The SI shall provide guaranteed availability for various types of Severity levels as specified in clause 0.The non-availability hours for availability calculation may be reckoned from the end of the allowed Action Resolution time. A standardized register shall be maintained at each site containing full details of each outages, actions taken by Utility to correct the problem, applicable

Severity level, time of reporting to the Contractor support engineer/support centers pursuant to the appropriate methods in the Agreement, allowed Response time as per the Response times defined in clause 0, actual Resolution time, and signature of Engineer-in-charge as well as the SIs 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

9.1 Penalty Applicable during Implementation Period

The rollout of SCADA DMS System including all the applications/supporting system in all the project areas has to be completed by the SI as mentioned in RFP or as per the agreed roll out plan.

Any delay in the SCADA System 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.

Sl. No.	Project Phases	Timelines	Penalty for Delay
1.	**Contract Finalization and Award of Work**	T	
2.	**Project Initiation Phase:**	T + 4 months	1% per month or part there of maximum up to 10% of the total cost quoted for SCADA DMS system Implementation
3.	**Design Blueprinting Phase of DC, DCC, NOC and SOC:**	T + 6 months	1% per month or part there of maximum up to 10% of the total cost quoted for DC , DCC, NOC, SOC Civil Build and Non IT Infrastructure.
4.	**Design Blueprinting Phase of SCADA System:**	T + 7 months	1% per month or part there of maximum up to 10% of the total cost quoted for SCADA DMS system Implementation
5.	**DC, NOC, SOC, DCC Civil and Non IT Infrastructure I&C**	T + 16 months	1% per month or part there of maximum up to 10% of the total cost quoted for DC , DCC, NOC, SOC Civil Build and Non IT Infrastructure
6.	**SCADA DMS System IT and Field Infrastructure I&C**	T + 18 months	1% per month or part there of maximum up to 10% of the total cost quoted for SCADA DMS system Implementation

Sl. No.	Project Phases	Timelines	Penalty for Delay
7.	**SCADA DMS System Design**	T + 20 months	1% per month or part there of maximum up to 10% of the total cost quoted for SCADA DMS system Implementation
8.	**SCADA DMS Roll Out**	T + 22 months	1% per month or part there of maximum up to 10% of the total cost quoted for SCADA DMS system Implementation
9.	**Go-Live Phase SCADA DMS**	T + 24 months	0.5% per week or part there of maximum up to 10% of the total cost quoted for SCADA DMS system Implementation

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 2 years. In such case, the NEA reserves the right to get the remaining part of project work completed from other agencies at the cost of the SI.

9.2 Availability computation for SCADA-DMS System

Availability would be on per quarter basis. The formula to be used for availability computation would be as under:

Availability per quarter (per site) = $\frac{THQ - (S1 \times 1 + S2 \times 0.4 + S3 \times 0.1)}{THQ} \times 100\%$

Where THQ is total hours in the quarter

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 SCADA-DMS System availability)

In the event of availability below a certain level, the maintenance charges would be proportionately reduced as follows:

For overall system availability

Availability per quarter	**Deduction as % of the apportioned price of total FMS for SCADA-DMS portion of the contract applicable for that site**
> 99%	NIL
Less than 99%	Deduction of 2% of the apportioned price of the apportioned quarterly FMS for every 1% or part there of decrease in availability under 99%

For individual hardware & non- critical functions

Availability per quarter	**Deduction as % of the apportioned price of total FMS for SCADA-DMS portion of the contract applicable for that site**
> 98%	NIL

Availability per quarter	Deduction as % of the apportioned price of total FMS for SCADA-DMS portion of the contract applicable for that site
Less than 98%	Deduction of 2% of the apportioned price of the apportioned quarterly FMS for every 1% or part there of decrease in availability under 98%

While calculating Availability following shall be considered:

a) The Overall SCADA/DMS System shall be considered as available if
b) All SCADA applications are available
c) All DMS applications are available
d) All SCADA/DMS functions described in the specification are executed at periodicities specified in the specification. without degradation in the response times
e) Requests from available Operator Consoles & VPS are processed
f) Information Storage and Retrieval applications are available
g) Data exchange with other system is available
h) One of the redundant hardware is available so that all the SCADA/DMS applications are functional to ensure the design & performance requirement as envisaged in the RFP

Further, Non-Availability of RTU/ /FRTUs/FPI/ System shall not be considered for calculating Overall SCADA/DMS System Availability.

However, each device, including RTU, FRTU & Servers etc. shall individually exhibit a minimum availability of 98%. Further, the non-availability of following Non-Critical functions shall not be considered for calculations of SCADA/DMS System availability, however these functions should be available for 98% of the time.

a) Database modification and generation
b) Display modification and generation
c) Report modification and creation
d) DTS

The computation of Availability / Non-availability would be rounded up to 2 decimal places at each Contract Co-ordination Site on quarterly basis and any deduction in the maintenance charges thereof would be calculated as stated above in Clause 9.2 on pro-rata basis.

9.3 Operation Service Levels for DC 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 Data Center. These SLAs shall be strictly imposed for the target performance metrics as outlined in the table below.

Sr.No	Measurement Parameter	Target	Severity	Penalty applicable on quarterly FMS charges payable towards DC Maintenance
1.	Power availability (UPS output)	>= 99.749%	Critical	No Penalty
		<99.749% to >= 99 %		1 % of Quarterly Bill
		>=98% to <99%		2 % of Quarterly Bill
		>=95% to <98%		3 % of Quarterly Bill
		<95%		5% of Quarterly Bill
2		>= 99.749%	Critical	No Penalty

Sr.No	Measurement Parameter	Target	Severity	Penalty applicable on quarterly FMS charges payable towards DC Maintenance
	PAC system Availability including redundant units. maintained 21°± 2° at all times Relative humidity to be maintained 50°± 5° at all times	<99.749% to >= 99 %		1 % of Quarterly Bill
		>=98% to <99%		2 % of Quarterly Bill
		>=95% to <98%		3 % of Quarterly Bill
		<95%		5% of Quarterly 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 Quarterly Bill
		>=98% to <99%		2 % of Quarterly Bill
		>=95% to <98%		3 % of Quarterly Bill
		<95%		5% of Quarterly 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 repellant etc. For any component Downtime, the penalty will be applicable	>= 99.749%	Critical	No Penalty
		<99.749% to >= 99 %		1 % of Quarterly Bill
		>=98% to <99%		2 % of Quarterly Bill
		>=95% to <98%		3 % of Quarterly Bill
		<95%		5% of Quarterly Bill

10. Annexures

10.1 Annexure – 1 : IT EQUIPMENT SPECIFICATIONS

Minimum Technical Specifications Requirements

Sl. No.	IT Infrastructure - Item
1.	Server
2.	SAN Storage
3.	SAN Switch
4.	Backup Storage
5.	External and Internal Intrusion Prevention System
6.	Backup Software
7.	HIPS with Antivirus
8.	Layer 3 Core Switch
9.	Layer 3 DMZ & GPS Receiver Switch
10.	24 Port Managed Access Switch
11.	48 Port Managed Access Switch
12.	External and Internal Firewall

Instructions for filling the annexure documents

1. It is mandatory to fill up all sheets provided under this Annexure
2. Bidder should fill up the specification sheets in the given format using MS-Excel.
3. Bidder should ensure that none of the listed parameters are modified, deleted and no additional parameter is added. (Remarks, if any, should be indicated separately in the Remarks column)
4. In case, the bidder is proposing any additional product category that is not listed in this section, he may use additional sheets.
5. In case, the software proposed by the bidder has multiple modules/components that are priced and sold separately, the bidder should use additional sheets for each such module/component and include the licensing policy and number of licenses proposed for the same in the respective sheets. The same should also be reflected in the Commercial Bid format as new line items with the above said references.
6. Wherever minimum requirements are specified, it is mandatory to indicate with a YES or NO, whether the solution being offered complies with the minimum requirements stated. In case of non-compliance, details/remarks must be provided.
7. It is mandatory to fill up the "Bidder's Response" column against all the listed parameters / features.
8. Incomplete/ missing information or information not adhering to the prescribed format may not be considered during evaluation of bid and/or for award of marks.
9. Bidder is advised not to make any changes to any information in the Techno functional requirements. For example, insert a row or delete a row or modify any other information like change the functionality required, etc. In case the bidder modifies any information, the response would be rejected.
10. The requirements provided are minimum value. It is the responsibility of the bidder to provide the optimum size of the equipment and its component to ensure trouble-free and smooth operation after proper study of the system requirement. The bidder is required to provide necessary design parameter to prove the requirement.
11. The server shall be suitable to accommodate the functioning of the distribution control center which will control the distribution system and equipment, which is proposed to be developed in the future (within few years).

12. **The bidder shall mandatorily submit a detailed justification of the BOM proposed by the bidder as part of their bid submission. The justification shall cover the make, model , specifications and high level solution architecture proposed by the bidder. The same shall be assessed by NEA for efficacy of the proposed solution.**

10.1.1 Servers

Application Server

Sl. No.	Item	Minimum Requirement Description	Compliance (Yes / No)	Deviations /Remarks
Make				
Model				
1.	Application Server	Latest generation x86 Server with 4* Xeon Gold (2.4GHz) / equivalent AMD Processor or higher. Bidder to Submit documentary proofs for equivalence		
2.		Maximum cache available with the processor		
3.	Main Memory	Should have 256 GB RAM expandable to 512 GB		
4.	RAS Features	Hot Pluggable Disk Drives		
5.		Redundant Power Supply at server / rack level		
6.		Redundant hot swappable fans at server level		
7.	Hard Disks	4*600 GB SAS 6Gbps 2.5in Hot-plug Hard Drives		
8.		RAID		
9.		Integrated RAID offering Striping, Mirroring (RAID 0, 1)		
10.	Network Interface	Minimum 2Nos. 10 Gbps Ethernet ports		
11.		USB		
12.		Minimum 1 USB 2.0 ports or an option for connecting USB devices		
13.	Virtualization	The server should support virtualization technology and a software defined datacentre network infrastructure		
14.		Server should have certified to run minimum of 150,000 TPC-H Query / Hour. Note: TPC-H Benchmark certificate would be considered for same series/model of Server being offered even with different CPU configuration but meeting or exceeding the TPC-H numbers		
15.		Form Factor: Rack mountable / Blade (In case Bidder is offering Blade Server - Blade Chasis should be Provided by Bidder)		

Database Server

Sl. No.	Item	Minimum Requirement Description	Compliance (Yes / No)	Deviations /Remarks
Make				
Model				
1.	Database Servers	Latest generation x86 Server with 4* Xeon Gold (3.2GHz) / equivalent AMD Processor or higher. Bidder to Submit documentary proofs for equivalence		
2.		Maximum cache available with the processor		
3.	Main Memory	Should have 256 GB RAM expandable to 512 GB		
4.	RAS Features	Hot Pluggable Disk Drives		
5.		Redundant Power Supply at server / rack level		
6.		Redundant hot swappable fans at server level		
7.	Hard Disks	4*600 GB SAS 6Gbps 2.5in Hot-plug Hard Drives		
8.	RAID	Integrated RAID offering Striping, Mirroring (RAID 0, 1)		
9.	Network Interface	Minimum 2Nos. 10 Gbps Ethernet ports		
10.		Minimum 2Nos. 16Gbps auto negotiable FC HBA ports (connecting to Storage)		
11.		Both Ethernet / FC ports should be in redundant mode		
12.	USB	Minimum 1 USB 2.0 ports or an option for connecting USB devices		
13.	Virtualization	The server should support virtualization technology and a software defined datacentre network infrastructure		
14.		Server should have certified to run minimum of 150,000 TPC-H Query /Hour.Note: TPC-H Benchmark certificate would be considered forsame series/model of Server being offered even with different CPU configuration but meeting or exceeding the TPC-H numbers		
15.		Form Factor: Rack mountable / Blade (In case Bidder is offering Blade Server - Blade Chasis should be Provided by Bidder)		

Web Server

Sl. No.	Item	Minimum Requirement Description	Compliance (Yes / No)	Deviations /Remarks
Make				
Model				
1.	Web Server	Latest generation x86 Server with 4* Xeon Gold (2.4GHz) / equivalent AMD Processor. Bidder to Submit documentary proofs for equivalence		
2.		Maximum cache available with the processor		
3.	Main Memory	Should have 128 GB RAM expandable to 512 GB		
4.	RAS Features	Hot Pluggable Disk Drives		
5.		Redundant Power Supply at server / rack level		
6.		Redundant hot swappable fans at server level		
7.	Hard Disks	4*600 GB SAS 6Gbps 2.5in Hot-plug Hard Drives		
8.	RAID	Integrated RAID offering Striping, Mirroring (RAID 0, 1)		
9.	Network Interface	Minimum 2Nos. 10 Gbps Ethernet ports		
10.				
11.				
12.	USB	Minimum 1 USB 2.0 ports or an option for connecting USB devices		
13.	Virtualization	The server should support virtualization technology and a software defined datacentre network infrastructure		
14.		Server should have certified to run minimum of 150,000 TPC-H Query /Hour. Note: TPC-H Benchmark certificate would be considered for same series / model of Server being offered even with different CPU configuration but meeting or exceeding the TPC-H numbers		
15.		Form Factor: Rack mountable / Blade (In case Bidder is offering Blade Server - Blade Chasis should be Provided by Bidder)		

Backup Server

Sl. No.	Item	Minimum Requirement Description	Compliance (Yes / No)	Deviations / Remarks
Make				
Model				
1.	Backup Server Requirement- 3	Latest generation x86 Server with 2* Xeon Gold (2.4 GHz) / equivalent AMD Processor or higher. Bidder to Submit documentary proofs for equivalence		
2.		Maximum cache available with the processor		
3.	Main Memory	Should have 128 GB RAM expandable to 512 GB		
4.	RAS Features	Hot Pluggable Disk Drives		
5.		Redundant Power Supply at server / rack level		
6.		Redundant hot swappable fans at server level		
7.	Hard Disks	2*600 GB SAS 6Gbps 2.5in Hot-plug Hard Drives		
8.	RAID	Integrated RAID offering Striping, Mirroring (RAID 0, 1)		
9.	Network Interface	Minimum 2Nos. 10 Gbps Ethernet ports		
10.		Minimum 2Nos. 16Gbps auto negotiable FC HBA ports (connecting to Storage)		
11.		Both Ethernet / FC ports should be in redundant mode		
12.	USB	Minimum 1 USB 2.0 ports or an option for connecting USB devices		
13.	Virtualization	The server should support virtualization technology and a software defined datacentre network infrastructure		
14.		Server should have certified to run minimum of 1,50,000 TPC-H Query /Hour. Note: TPC-H Benchmark certificate would be considered for same series/model of Server being offered even with different CPU configuration but meeting or exceeding the TPC-H numbers		
15.		Form Factor: Rack mountable / Blade (Incase Bidder is offering Blade Server - Blade Chasis should be Provided by Bidder)		

DNS/ LDAP Server

Sl. No.	Item	Minimum Requirement Description	Compliance (Yes / No)	Deviations /Remarks
Make				
Model				
16.	Application Server	Latest generation x86 Server with 4* Xeon Gold (2.4GHz) / equivalent AMD Processor or higher. Bidder to Submit documentary proofs for equivalence		
17.		Maximum cache available with the processor		
18.	Main Memory	Should have 256 GB RAM expandable to 512 GB		
19.	RAS Features	Hot Pluggable Disk Drives		
20.		Redundant Power Supply at server / rack level		
21.		Redundant hot swappable fans at server level		
22.	Hard Disks	4*600 GB SAS 6Gbps 2.5in Hot-plug Hard Drives		
23.		RAID		
24.		Integrated RAID offering Striping, Mirroring (RAID 0, 1)		
25.	Network Interface	Minimum 2Nos. 10 Gbps Ethernet ports		
26.		USB		
27.		Minimum 1 USB 2.0 ports or an option for connecting USB devices		
28.	Virtualization	The server should support virtualization technology and a software defined datacentre network infrastructure		
29.		Server should have certified to run minimum of 1,50,000 TPC-H Query /Hour. Note: TPC-H Benchmark certificate would be considered for same series/model of Server being offered even with different CPU configuration but meeting or exceeding the TPC-H numbers		
30.		Form Factor: Rack mountable / Blade (In case Bidder is offering Blade Server - Blade Chasis should be Provided by Bidder)		

10.1.2 SAN Storage

Sl. No.	Item	Minimum Requirement Description	Compliance (Yes / No)	Deviations / Remarks
Make				
Model				
1.		The Storage system should have unified capability i.e. should support block and file access with host connectivity for FC, iSCSI, NFS and CIFS. Any hardware/software required for this functionality shall be supplied along with it in NSPOF mode per storage controller.		
2.		The Storage system should have at least two controllers running in an active-active mode with automatic failover to each other in case of one/any controller failure.		
3.		The system should be dedicated appliance with specifically optimized OS to provide both SAN and NAS functionalities. The architecture should allow modular upgrades of and software for investment protection. The system should be suitably configured for achieving enhanced performance and throughput.		
4.		The storage system should have dual controllers with automatic failover capabilities in case of one controller. The storage should be installed in the OEM Rack to be supplied.		
5.		Easy to use GUI based or web enabled administration interface for configuration, storage management for all protocols asked i.e. both SAN and NAS Management. Performance management tools should show detailed real time and historical key performance characteristics like, Read and Write IOPS, Throughput in MB/s or GB/s, controller utilization, disk utilization, capacity utilization etc. Management GUI shall support scheduling email of reports for above performance metrics."		
6.		The storage system should configure at least 8*16Gbps FC ports.. The Storage System should support Raid Levels 0, 5, 6, 10 or equivalent data protections. Multiple raid configurations to be configured in the proposed solution.		
7.		The Storage System should have support for SSD, SAS Drives, and NL SAS Drives. The storage system should have support for 12Gpbs SAS 3.0 drives. Proposed system should be able to support all on-line data storage tiers to maximize both system performance and capacity scalability. Proposed system should support flash, 10K RPM, 15K RPM as well as 7.2K RPM drives.		

Sl. No.	Item	Minimum Requirement Description	Compliance (Yes / No)	Deviations / Remarks
Make				
Model				
8.		The storage system should be supplied with 50TB of usable disk space at RAID 5 using not more than 1.8TB SAS HDD. Offered Storage shall be configured with Min of 128GB of cache.		
9.		The Storage System should have the capability to support Non-Disruptive Data migration across Volumes. The Storage System Should be configured with host multi-pathing drivers.		
10.		No replacement or upgrade of controllers should be required for supporting the 500 disks. It should be a single or tightly clustered singly managed system rather than aggregate of multiple separate smaller boxes.		
11.		The storage should have the ability to create logical volumes without physical capacity being available (Thin Provisioned) or in other words system should allow overprovisioning of the capacity. The feature should be made available for the maximum supported capacity.		
12.		For file access It should be possible to set quotas and should have LDAP integration. Support for heterogeneous client Operating System platforms (on both block and file level) like LINUX, Microsoft Windows, HP-UX, SUN Solaris, IBM-AIX, ESXi, etc.		
13.		The Storage System should have the Capability to support creation of instantaneous or Point in Time Snapshot copies of volumes. The snapshot feature should support incremental and thin provisioned volumes.		
14.		The solution should support virtual infrastructure (like VMware / Hyper-V etc.). Should have capabilities for booting VMs from the SAN. Should be supplied with virtualization aware APIs for provisioning and managing the storage array from the virtual infrastructure.		
15.		The solution should support movement of data between different disk tiers based on predefined policies (i.e. storage tiring). Licensing should be provided. The Storage System should support Synchronous & Asynchronous Replication for DR Strategy such as for a Single Lun.		
16.		Easy to use GUI based and web enabled administration interface for configuration, managing and administration of file & block storage and associated functionalities including deployment, automation, provisioning, and protection and monitoring management. Solution Should offer real time		

Sl. No.	Item	Minimum Requirement Description	Compliance (Yes / No)	Deviations / Remarks
Make				
Model				
		performance monitoring tools giving information on CPU utilization, volume throughput, I/O rate and latency.		
17.		The Storage box should be connected to the servers through SAN switches in High Available Configuration. All necessary cables for connecting the storage with switches are to be supplied.		
18.		Solution should be fully compatible with all standard backup software's.		

10.1.3 SAN Switch

Sl. No.	Item	Minimum Requirement Description	Compliance (Yes / No)	Deviations / Remarks
Make				
Model				
1.		Should have minimum 16 Active ports and support for 24 FC ports (each with minimum port speed 16Gbps).		
2.		SAN Extension should have at least 2 numbers of 10 Gbps ports for SAN extension over WAN.		
3.		Should support FCIP protocol.		
4.		Should have capability of port trunking.		
5.		Should have optical transceivers for short wave and long wave.		
6.		Should have GUI based management software for administration and configuration.		
7.		Should be possible to configure the switches with alerts.		
8.		Should support zoning configuration or equivalent.		
9.		Should support fabric routing to enable cross fabric connectivity or equivalent.		
10.		All other necessary fibre cables and racking accessory should be supplied.		
11.		Should have inbuilt diagnostic features like Online Diagnostics, power on self-test, Online Health System or equivalent etc.		
12.		Should support RADIUS authentication or SSH.		

10.1.4 Backup Storage

Sl. No.	Item	Minimum Requirement Description	Compliance (Yes / No)	Deviations / Remarks
Make				
Model				
1.		The Storage system should have unified capability i.e. should support block and file access with host connectivity for FC, iSCSI, NFS and CIFS. Any hardware/software required for this functionality shall be supplied along with it in NSPOF mode per storage controller.		
2.		The Storage system should have at least two controllers running in an active-active mode with automatic failover to each other in case of one/any controller failure.		
3.		The system should be dedicated appliance with specifically optimized OS to provide both SAN and NAS functionalities. The architecture should allow modular upgrades of software for investment protection. The system should be suitably configured for achieving enhanced performance and throughput.		
4.		The storage system should have dual controllers with automatic failover capabilities in case of one controllerThe storage should be installed in the OEM Rack to be supplied.		
5.		Easy to use GUI based or web enabled administration interface for configuration, storage management for all protocols asked i.e. both SAN and NAS Management. Performance management tools should show detailed real time and historical key performance characteristics like, Read and Write IOPS, Throughput in MB/s or GB/s, controller utilization, disk utilization, capacity utilization etc. Management GUI shall support scheduling email of reports for above performance metrics."		
6.		The storage system should configure at least 8*10GE ports. The Storage System should support Raid Levels 0, 5, 6, 10 or equivalent data protections. Multiple raid configurations to be configured in the proposed solution.		
7.		The Storage System should have support for SSD, SAS Drives, and NL SAS Drives. The storage system should have support for 12Gpbs SAS 3.0 drives. Proposed system should be able to support all on-line data storage tiers to maximize both system performance and capacity scalability. Proposed system should support flash, 10K RPM, 15K RPM as well as 7.2K RPM drives..		

Sl. No.	Item	Minimum Requirement Description	Compliance (Yes / No)	Deviations / Remarks
Make				
Model				
8.		The storage system should be supplied with 200TB of usable disk space at RAID 6 using not more than 10TB NL SAS.Offered Storage shall be configured with Min of 64 GB of cache.		
9.		The Storage System should have the capability to support Non-Disruptive Data migration across Volumes. The Storage System Should be configured with host multi-pathing drivers.		
10.		No replacement or upgrade of controllers should be required for supporting the 200 disks. It should be a single or tightly clustered singly managed system rather than aggregate of multiple separate smaller boxes.		
11.		The storage should have the ability to create logical volumes without physical capacity being available (Thin Provisioned) or in other words system should allow overprovisioning of the capacity. The feature should be made available for the maximum supported capacity.		
12.		For file access It should be possible to set quotas and should have LDAP integration. Support for heterogeneous client Operating System platforms (on both block and file level) like LINUX, Microsoft Windows, HP-UX, SUN Solaris, IBM-AIX, ESXi, etc.		
13.		The Storage System should have the Capability to support creation of instantaneous or Point in Time Snapshot copies of volumes. The snapshot feature should support incremental and thin provisioned volumes.		
14.		The solution should support virtual infrastructure (like VMware / Hyper-V etc.). Should have capabilities for booting VMs from the SAN. Should be supplied with virtualization aware APIs for provisioning and managing the storage array from the virtual infrastructure.		
15.		The solution should support movement of data between different disk tiers based on predefined policies (i.e. storage tiring). Licensing should be provided. The Storage System should support Synchronous & Asynchronous Replication for DR Strategy such as for a Single Lun.		
16.		Easy to use GUI based and web enabled administration interface for configuration, managing and administration of file & block storage and associated functionalities including deployment, automation, provisioning, and protection and monitoring management. Solution Should offer real time performance monitoring tools giving information on		

Sl. No.	Item	Minimum Requirement Description	Compliance (Yes / No)	Deviations / Remarks
Make				
Model				
		CPU utilization, volume throughput, I/O rate and latency.		
17.		The Storage box should be connected to the servers through SAN switches in High Available Configuration. All necessary cables for connecting the storage with switches are to be supplied.		
18.		Solution should be fully compatible with all standard backup software's.		

10.1.5 Tape Library

Sl. No.	Item	Minimum Requirement Description	Compliance (Yes / No)	Deviations / Remarks
Make				
Model				
1.		Drive Type - LTO Generation 8.		
2.		Tape library should be offered with min 8*LTO8 drives and 100 slots.		
3.		Offered LTO8 drive in the Library shall conform to the Continuous and Data rate matching technique for higher reliability.		
4.		Offered LTO8 drive shall have native speed of at least 300MB/sec and a compressed speed of 600 MB/sec..		
5.		Offered LTO8 drive in the library shall offer WORM and AES 256bit encryption.		
6.		Offered tape Library shall provide the granular modularity and scalability in the increments of 100 slots.		
7.		Should be offered with redundant power supply		
8.		RAS Features Hot-swappable drives; Tape Library shall provide remote monitoring capability.		
9.		Supported Host Platform AIX, Linux, Solaris, Windows.		
10.		Offered tape Library shall be Modular design to allow configuration, add capacity and increase performance.		

10.1.6 Internal and External Intrusion Prevention System

Sl. No.	Item	Minimum Requirement Description	Compliance (Yes / No)	Deviations / Remarks
Make				
Model				
1.		~~The device should be a purpose built dedicated appliance (not a subset of firewall or UTM appliance)~~.		
2.		The device should accurately detect the following Attack categories: -		
3.		a) Unauthorized access attempts		
4.		b) Pre-attack probes		
5.		c) DoS		
6.		d) Vulnerability exploitation		
7.		e) Zero-day attacks.		
8.		The device should support both IPv4 & IPv6 simultaneously (Dual Stack).		
9.		The device should support botnet protection based on:		
10.		a) BOT detection		
11.		b) Command and control database		
12.		The device should have separate dedicated interface for management.		
13.		IPS (Intrusion Prevention Systems) should detect and actively prevent attacks in real-time		
14.		Should support 5 Gbps throughput or more		
15.		The IPS should work in a non-intrusive mode and be able to monitor all the major TCP/IP protocols, including IP, Internet Control Message Protocol (ICMP), TCP, and User Datagram Protocol (UDP)		
16.		The IPS should state fully decode application-layer protocols such as FTP, Simple Mail Transfer Protocol (SMTP), HTTP, Domain Name System (DNS), remote procedure call (RPC), NetBIOS, NNTP and Telnet.RIP Version 2 passive mode support		
17.		The platforms on which the IPS tools run on should be appliance sensors which are hardware/software devices and should be latest in the series		
18.		The IPS system itself is protected against attacks and uses no services on the host that might make it vulnerable to attack		
19.		User-specified signatures can be created based upon content; i.e. string matching		
20.		On power, up the IPS should use built-in system monitoring & diagnostics before going online to detect failure of hardware		
21.		Extensive debugging capabilities to assist in hardware problem resolution		

Sl. No.	Item	Minimum Requirement Description	Compliance (Yes / No)	Deviations / Remarks
Make				
Model				
22.		Product can process host traffic at an acceptable rate with all the attack signatures active		
23.		Support Hybrid IDS/IPS services that allow a single sensor to operate simultaneously both as an IDS sensor and an IPS sensor		
24.		IPS device should have features to prioritize alerts after an alert action is taken place e.g if a high priority attack is dropped, the alert should be log, however if a high priority attack is allowed, the alert should be an email		
25.		The ability to define a default operating system that will be used in the attack relevance calculation - e.g if a Linux based attack is targeted towards a windows server, the alert severity of the attack should be lowered		
26.		The ips should have the ability to dynamically understand the risk posed by an attack to the network to best adjust the rating of the alert. This risk should be assessed via various parameters like relevancy of an attack (Linux vs. windows) and value of target (printer vs. server)		
27.		The sensors should be able to detect attacks running inside of these tunnelling protocols - GRE, IP-in-IP, MPLS, and IPv6		
28.		Ability to identify attacks in IPv6 environments through the inspection of IPv4 traffic being tunnelled in IPv6		
29.		exceptions be setup to filter out, fine-tune or adjust the actions for specific attacker or destination IP on a per signature basis		
30.		System protect against “generic” attack indications such as remote “shell code		
31.		It Should support to block attacks using protocols that are using non-standard ports		
32.		The proposed solution should be able to detect & mitigate zero-day DDoS attacks, based on behavioural DoS detection & mitigation.		
33.	IPS Management System	Communication between the IPS Management System and the IPS Sensor should be encrypted.		
34.		Should have an updateable pattern file for up to date protection from the newest threats and methods of attack.		
35.		Vendor must provide signature updates and must have a facility for automatically distributing these		

Sl. No.	Item	Minimum Requirement Description	Compliance (Yes / No)	Deviations / Remarks
Make				
Model				
		updates to all intrusion detection servers in the organization		
36.		Should be easy to update monitoring, blocking, and alerting rules		
~~37.~~		Product should have the capability of backing up the configuration details using a backup server and the transmission should be encrypted	-	
38.		The Management System should be able to automatically download the latest signature files off the Bidder's web/ftp site.		
39.		The Bidder should provide updated signature files for any attacks carried out in any part of the world once a remedy is found; by automatically updating its web/ftp site and generating an e-mail with the respective signature files to the administrator.		
40.		Vendor should provide updated signature files on weekly basis by making them available on its web/ftp site.		
41.		Product should have the capability of scheduling the auto backup's facility and auto updating of signature files.		
42.		The product's sensor and the management console should seamlessly talk to each other on a TCP/IP network.		
43.		The product should have a centralized management system		
44.		Web based management software and command line interface support		
45.		Management software should run on standard, commercial off-the-shelf hardware platforms and operating systems		
46.		Network management services should be provided using standards based protocols like SNMP & SNMP V2		
47.	Reporting	Should provide a comprehensive system for capturing information and making it available for analysis. Should provide the ability to filter, sort, and view the archived information, and to create detailed reports.		
48.		Administrators should be able to view alerts and generate reports based on the consolidated information		

Sl. No.	Item	Minimum Requirement Description	Compliance (Yes / No)	Deviations / Remarks
Make				
Model				
49.		Must give detailed statistical reports on numbers of policy violations and where they came from, web usage, protocol distribution etc.		
50.		Product should have a comprehensive “drilldown” querying and reporting facility of intrusion events that took place off the database		
51.		Product should provide real-time statistics of the intrusion events detected, which could be represented in a graphical form.		
52.	Features for NIPS	Must protect the network from threats low-level protocol attacks and server and desktop intrusions.		
53.		Should detect attack patterns in network traffic that indicate potential intrusions, attacks, and abuses and take appropriate action based upon predefined policies, even while such attacks are in progress		
54.		Should be able to monitor all the ports in the switch of the network		
55.		Should be able to work on servers of different platforms of OS. (Please specify the list of OSs)		
56.		Support for packet reassembly		
57.		Detection of attacks due to misuse of protocols		
58.		Anomaly based intrusion detection		
59.		Check for Security attacks at layer 2 to Layer 7		
60.		Monitoring the logs of different network systems for policy violation		
61.		Product detects incidents based on patterns in network traffic that indicate malicious intent (pattern-based signatures)		
62.		Product's pattern-based signatures have a strong sense of context, so that false positives are minimized		
63.		IPS should be a dedicated hardware module or hardware appliance		
64.		Support creation of baseline of normal network traffic		
65.		Should be able to correctly track TCP sessions in complex network configurations		
66.		Support inspection and mitigation of threats in Multiprotocol Label Switching (MPLS) environments		
67.		IPS interfaces should be configurable for different types of connections; In-line, Span, Tap		

10.1.7 Backup Software

Sl. No.	Item	Minimum Requirement Description	Compliance (Yes / No)	Deviations / Remarks
Make				
Model				
1.		Should support both automatic and manual backup, incremental and full back up facility.		
2.		Should have some GUI for centralized management which should support heterogeneous platform and ensure easy administration.		
3.		Should support various offered OS platforms and be capable of supporting SAN based backup/restore from various platforms.		
4.		Should can take backup of SAN environment as well as LAN based backup. The proposed backup solution shall be configured in such a fashion that no extra license for client and media servers is required while moving from LAN to SAN based backup.		
5.		The proposed backup solution shall be unrestricted use that is it should allow CTD to configure without any restriction of client / media licenses for both SAN based backup and LAN based backup.		
6.		Should support encryption.		
7.		Should have robust backup scheduling capabilities. Should support and have in-built media management and supports cross platform device & media sharing in SAN environment.		
8.		Capability to restore the Backup system in the event of failure.		
9.		Should have LAN-free Backup/Restore capabilities.		
10.		Capability to configure retries for backups of a clients in case the clients is not available on the network due to reboot or network failures.		

10.1.8 Antivirus

Sl. No.	Item	Minimum Requirement Description	Compliance (Yes / No)	Deviations / Remarks
Make				
Model				
1.	Centrally Managed Antivirus Solution	The Central Management Solution should have capabilities to manage the Servers at Primary site & DR Site.		
2.		The Central Management Solution should be bundled with all required hardware, software, software subscription (software license) and service support for managing Antivirus solution.		
3.		The Central Management solution hardware configuration should can manage all the servers and should be scalable for entire NEA endpoints		
4.		Solution should ensure the performance of Central Management Server if any distribution or relay server becomes bottleneck and endpoints connectivity and proper syncing up to the Central Management Server deployed by the bidder.		
5.		Solution should ensure that all managed endpoints under the distribution/relay server takes updates on regular basis but at the same time the performance of endpoints should not be reduced due to the performance of Central Management /distribution/relay server deployed by the bidder.		
6.	Host Integrity Management	Solution should ensure that secure authentication between endpoints and Central Management server for any software/signature update of the solution to the manage endpoints only.		
7.		Solution should ensure that only managed endpoints take updates through distribution or relay system.		
8.	Antivirus and Anti-Spam	Solution should scan, detects, and clean/delete/quarantine the infected files.		
9.		Solution should block/clean/delete malicious code/software in real time, including viruses, worms, Trojan		

Sl. No.	Item	Minimum Requirement Description	Compliance (Yes / No)	Deviations / Remarks
Make				
Model				
		horses, bot, spyware, adware and Rootkit.		
10.		Solution should have embedded behavioural analysis and protection technology apart from signature based clean/delete/quarantine for unknown threats.		
11.		Solution should protect the data transfer from endpoints to the hacker system spoofed IP or MAC address. (Anti IP and MAC spoofing).		
12.		Solution should support to install AV Agent through various techniques like web based, MSI package or any other sources in workgroup and Active Directory environment.		
13.		Solution should support throttling of CPU process during real time and conventional scan for improving the performance endpoints during the execution user routine task.		
14.		Solution should support to scan single file/directory/entire system and detect (clean or delete or quarantine).		
15.		Solution should scan, detect, clean or delete malicious code software for protocols POP3, POP3S, SMTP, and SMTPS.		
16.		Solution should support to prompt a message whenever any external devices plugged into the endpoints and scan, detect, clean, delete, quarantine and also support manual scan, detect (Clean or delete or quarantine).		
17.		Solution should support scheduled scan configuration for full- disks scan at designated time from central server for clean, delete, quarantine malicious program.		
18.		Solution should support to prevent endpoints users not to uninstall or disable managed Antivirus services without authenticated password.		

Sl. No.	Item	Minimum Requirement Description	Compliance (Yes / No)	Deviations / Remarks
Make				
Model				
19.		Solution should support to exclude the files/directories from real time and manual scan.		
20.		Solution should provide a utility software tool to the Antivirus support team for clean uninstallation of managed antivirus using authenticated password.		
21.	Antivirus Firewall	Solution should allow creating and deploying user defined firewall policy for endpoints to permit or deny network access based over IP Address, logical Ports, and Services on a single IP Address, range, and segments.		
	Device Control	Solution should support to block external devices like USB, Data Card, Infrared, and Bluetooth.		
22.		Solution should be able to provide permission to access authorized external devices based on privileges.		
23.	Supported Operating Systems	Solution should support all latest versions of Windows Operation Systems.		
24.	Reports	Solution should support to generate infected IP address with source and destination IP address.		
25.		Solution should support to generate following reports from console:		
26.		Current Virus Definition.		
27.		Virus Definition updates.		
28.	Antivirus Client System logs.	Solution should support to send endpoints logs automatically up to Central Management Server.		
29.		Solution should support that the managed endpoints should send Antivirus event logs.		
30.		Solution should support that the managed endpoints should send Antivirus firewall logs i.e. compliance violations and access log.		
31.		Solution should support to integrate with 3rd Party Log Analyser Application Software (SIEM and Sic. Log).		

Sl. No.	Item	Minimum Requirement Description	Compliance (Yes / No)	Deviations / Remarks
Make				
Model				
32.	Log Collection Utility Programs for Windows	Solution should provide a Utility Software Tool for all variant Windows Operation for collecting infected endpoints log for analysing and developing signatures which can clean the endpoints from Malware infection.		
33.	System Cleaning Tool	Solution should provide a system cleaning tools before installing Antivirus Agent on endpoints.		
34.	OEM Support	Solution should include 5 years antivirus software subscription and service support cost in the Antivirus Solution itself.		
35.		Solution should provide a Utility Software Tool for all variant other than Windows Operating System for collecting infected endpoints log for analysing and developing signatures which can clean the endpoints from Malware infection.		
36.		Solution should support following Operating Systems:		
37.		Linux (list all supported variants/versions).		
38.		MaC OS (list all supported versions).		
39.		Windows OS (list all supported versions).		
40.		Solution Should be IPV6 attacks Ready.		

10.1.9 Layer 3 Switches

SL. No.	Item	Minimum Requirement Description	Compliance (Yes / No)	Deviations / Remarks
Make				
Model				
1	**L3 Switch**	Switch supporting Full Enterprise Layer 3 image supporting IPv6 and BGP with the latest Firmware as available with Line rate non-blocking performance.		
2		The switch should support minimum 24 x 10Gb Base-T interfaces enabled from day one.		
3		The switch should support HA options in Active - Active or Active Backup configuration as required, all supporting features and licenses to be provided to support the same.		
4		Minimum 480 Gbps backplane or more with 5uS or better		
5		Minimum 300 million pps or better		
6		Minimum 256K MAC addresses		
7		4K 802.1Q vlans with 4K vlan ID support		
8		Should support 64K route table capacity for IPv4/IPv6		
9		Should support Static Route, RIP, OSPF, BGP, PBR from Day one for both IPv4 and IPv6 considering all License, software, hardware upgrades required if any.		
10		Should support Data Centre Infra, DCB, iSCSI FCoE considering all License.		
11		Should support all AAA functions with RADIUS and TACACS integration.		
12		Should support various strom control functions.		
13		Should support Intrusion Protection like functionality against various TCP/UDP attacks.		
14		Should support Control Plane / CPU protection using ACL and Qos.		
15		Should support 802.1x implementation using RADIUS		
16		Should support Standard, Extended Acls		
17		Should support encrypted communication between the user accessing the device namely using all access methods CLI, GUI or NMS via features like SSHv2, SSL, and SNMPv3 and Secure FTP/TFTP		
18		Should support third party networking operating system in future.		
19		The proposed switch should be offered with 2 FAN tray and Power Supply Redundancy (1+1).		
20		Operating temperature: 32° to 104°F (0° to 40°C)		
21		1 RJ45 console/management port with RS232 signalling, 1 RJ45 micro-USB-B console port, 1 RJ45 10/100/1000Base-T Out of Band management Ethernet port		
22		Should be ROHS Compliant		

SL. No.	Item	Minimum Requirement Description	Compliance (Yes / No)	Deviations / Remarks
Make				
Model				
23		EN 300 386, EN 55024, EN 61000-3-2, EN 61000-3-3, EN 61000-4-2, EN 61000-4-3, EN 61000-4-4, EN 61000-4-5, EN 61000-4-6 or equivalent standards		

10.1.10 Layer 3 DMZ and GPS Receiver Switch

SL. No.	Item	Minimum Requirement Description	Compliance (Yes / No)	Deviations / Remarks
Make				
Model				
1	**DMZ & GPS Receiver Switch**	Switch supporting Full Enterprise Layer 3 image supporting IPv6 and BGP with the latest Firmware as available with Line rate non-blocking performance.		
2		The switch should support minimum 12 x 10Gb Base-T interfaces enabled from day one.		
3		The switch should support HA options in Active - Active or Active Backup configuration as required, all supporting features and licenses to be provided to support the same.		
4		Minimum 240 Gbps backplane or more with 5uS or better		
5		Minimum 150 million pps or better		
6		Minimum 256K MAC addresses		
7		4K 802.1Q vlans with 4K vlan ID support		
8		Should support 64K route table capacity for IPv4/IPv6		
9		Should support Static Route, RIP, OSPF, BGP, PBR from Day one for both IPv4 and IPv6 considering all License, software, hardware upgrades required if any.		
10		Should support Data Centre Infra, DCB, iSCSI FCoE considering all License.		
11		Should support all AAA functions with RADIUS and TACACS integration.		
12		Should support various strom control functions.		

SL. No.	Item	Minimum Requirement Description	Compliance (Yes / No)	Deviations / Remarks
Make				
Model				
13		Should support Intrusion Protection like functionality against various TCP/UDP attacks.		
14		Should support Control Plane / CPU protection using ACL and Qos.		
15		Should support 802.1x implementation using RADIUS		
16		Should support Standard, Extended Acls		
17		Should support encrypted communication between the user accessing the device namely using all access methods CLI, GUI or NMS via features like SSHv2, SSL, and SNMPv3 and Secure FTP/TFTP		
18		Should support third party networking operating system in future.		
19		The proposed switch should be offered with 2 FAN tray and Power Supply Redundancy (1+1).		
20		Operating temperature: 32° to 104°F (0° to 40°C)		
21		1 RJ45 console/management port with RS232 signaling, 1 RJ45 micro-USB-B console port, 1 RJ45 10/100/1000Base-T Out of Band management Ethernet port		
22		Should be ROHS Compliant		
23		EN 300 386, EN 55024, EN 61000-3-2, EN 61000-3-3, EN 61000-4-2, EN 61000-4-3, EN 61000-4-4, EN 61000-4-5, EN 61000-4-6 or equivalent standards		

10.1.11 24 Port L2 Managed Access Switch for NoC, SoC and DCC.

Sl. No.	Minimum Requirement Description	Compliance (Yes / No)	Deviations / Remarks
Make			
Model			
1.	Switch should have 24 Nos. 10/100/1000 Base-TX auto-sensing plus with minimum 2x10G SFP+ uplinks.		
2.	Should support stacking		
3.	Switch should support link aggregation across multiple switches in a stack.		
4.	Switch should have non-blocking wire-speed architecture.		
5.	Switch should support IPv4 and IPv6 from day One		
6.	Switch should have non-blocking switching fabric of minimum 88 Gbps or more		
7.	Switch should have Forwarding rate of minimum 120 Mpps.		
8.	IEEE 802.1Q VLAN tagging.		
9.	802. 1Q VLAN on all ports with support for minimum 255 active VLANs and 1k VLAN ids		
10.	Support for 8k/16 k MAC addresses		
11.	Spanning Tree Protocol as per IEEE 802.1d		
12.	Multiple Spanning-Tree Protocol as per IEEE 802.1s		
13.	Rapid Spanning-Tree Protocol as per IEEE 802.1w		
14.	Self-learning of unicast & multicast MAC addresses and associated VLANs		
15.	Jumbo frames up to 9000 bytes		
16.	Link Aggregation Control Protocol (LACP) as per IEEE 802.3ad.		
17.	Port mirroring functionality for measurements using a network analyzer.		
18.	Switch should support IGMP v1 / v2 / v3 as well as IGMP v1 / v2 / v3 snooping.		
19.	Switch should support classification and scheduling as per IEEE 802.1P on all ports.		
20.	Switch should support QoS configuration on per switch port basis.		
21.	Switch should support classification and marking based on IP Type of Service (TOS) and DSCP.		
22.	Switch should provide traffic shaping and rate limiting features (for egress as well as ingress traffic) for specified Host, network, Applications etc.		
23.	Strict priority queuing guarantees that the highest-priority packets are serviced ahead of all other traffic.		
24.	Switch should support MAC address based filters/ access control lists (ACLs) on all switch ports.		

Sl. No.	Minimum Requirement Description	Compliance (Yes / No)	Deviations / Remarks
Make			
Model			
25.	Switch should support Port as well as VLAN based Filters/ ACLs.		
26.	Switch should support RADIUS and TACACS+ for access restriction and authentication.		
27.	Secure Shell (SSH) Protocol, HTTP and DoS protection		
28.	IP Route Filtering, ARP spoofing, DHCP snooping etc.		
29.	Should support DHCP snooping, DHCP Option 82, Dynamic ARP Inspection (DAI)		
30.	Should support a mechanism to shut down Spanning Tree Protocol Port Fast-enabled interfaces when BPDUs are received to avoid accidental topology loops.		
31.	Should support a mechanism to prevent edge devices not in the network administrator's control from becoming Spanning Tree Protocol root nodes.		
32.	Switch should support static ARP, Proxy ARP, IP source guard.		
33.	Switch should have a console port with RS-232 /RJ-45 Interface for configuration and diagnostic purposes.		
34.	Switch should be SNMP manageable with support for SNMP Version 1, 2 and 3.		
35.	Switch should support all the standard MIBs (MIB-I & II).		
36.	Switch should support TELNET and SSH Latest Version		
37.	Switch should support RMON (history, statistics, alarm and events).		
38.	Switch should support system and event logging functions as well as forwarding of these logs to multiple syslog servers.		
39.	Switch should support on-line software reconfiguration to implement changes without rebooting. Any changes in the configuration of switches related to Layer-2 & 3 functions, VLAN, STP, Security, QoS should not require rebooting of the switch.		
40.	Support for Automatic Quality of Service for easy configuration of QoS features for critical applications.		
41.	Support to detect unidirectional links caused by incorrect fibre-optic wiring or port faults and disable on fibre-optic interfaces		

Sl. No.	Minimum Requirement Description	Compliance (Yes / No)	Deviations / Remarks
Make			
Model			
42.	Switch should have comprehensive debugging features required for software & hardware fault diagnosis.		
43.	Should support DHCP Server feature to enable a convenient deployment option for the assignment of IP addresses in networks that do		
44.	DHCP servers configured on servers and integrated with Directory Services.		
45.	Switch should support Multiple privilege levels to provide different levels of access.		
46.	Switch should support NTP (Network Time Protocol)		
47	Switch should support FTP / TFTP		
48	RoHS Compliant.		
49	IEEE 802.1x support.		
50	IEEE 802.3x full duplex on 10BASE-T and 100BASE-TX ports.		
51	IEEE 802.1D Spanning-Tree Protocol.		
52	IEEE 802.1p class-of-service (CoS) prioritization.		
53	IEEE 802.1Q VLAN.		
54	IEEE 802.3u 10 BaseT / 100 Base Tx / 1000 Base Tx.		
55	Switch / Switch's Operating System should be tested and certified for EAL 2 /EAL3 / NDPP or above under Common Criteria Certification		

10.1.12 48 Port Managed Access Switch for NoC, SoC and DCC.

SL. No.	Minimum Requirement Description	Compliance (Yes / No)	Deviations / Remarks
Make			
Model			
1.	Switch should have 48 Nos. 10/100/1000 Base-TX auto-sensing plus with minimum 2x10G SFP+ uplinks.		
2.	Should support stacking using dedicated stacking ports		
3.	Switch should support link aggregation across multiple switches in a stack.		
4.	Switch should have non-blocking wire-speed architecture.		
5.	Switch should support IPv4 and IPv6 from day One		
6.	Switch should have non-blocking switching fabric of minimum 128 Gbps or more		
7.	Switch should have Forwarding rate of minimum 200 Mpps.		
8.	IEEE 802.1Q VLAN tagging.		
9.	802. 1Q VLAN on all ports with support for minimum 255 active VLANs and 1k VLAN ids		
10.	Support for 8k/16 k MAC addresses		
11.	Spanning Tree Protocol as per IEEE 802.1d		
12.	Multiple Spanning-Tree Protocol as per IEEE 802.1s		
13.	Rapid Spanning-Tree Protocol as per IEEE 802.1w		
14.	Self-learning of unicast & multicast MAC addresses and associated VLANs		
15.	Jumbo frames up to 9000 bytes		
16.	Link Aggregation Control Protocol (LACP) as per IEEE 802.3ad.		
17.	Port mirroring functionality for measurements using a network analyzer.		
18.	Switch should support IGMP v1 / v2 / v3 as well as IGMP v1 / v2 / v3 snooping.		
19.	Switch should support classification and scheduling as per IEEE 802.1P on all ports.		
20.	Switch should support QoS configuration on per switch port basis.		
21.	Switch should support classification and marking based on IP Type of Service (TOS) and DSCP.		
22.	Switch should provide traffic shaping and rate limiting features (for egress as well as ingress traffic) for specified Host, network, Applications etc.		
23.	Strict priority queuing guarantees that the highest-priority packets are serviced ahead of all other traffic.		
24.	Switch should support MAC address based filters/ access control lists (ACLs) on all switch ports.		

SL. No.	Minimum Requirement Description	Compliance (Yes / No)	Deviations / Remarks
Make			
Model			
25.	Switch should support Port as well as VLAN based Filters/ ACLs.		
26.	Switch should support RADIUS and TACACS+ for access restriction and authentication.		
27.	Secure Shell (SSH) Protocol, and DoS protection		
28.	IP Route Filtering, ARP spoofing, DHCP snooping etc.		
29.	Should support DHCP snooping, DHCP Option 82, Dynamic ARP Inspection (DAI)		
30.	Should support a mechanism to shut down Spanning Tree Protocol Port Fast-enabled interfaces when BPDUs are received to avoid accidental topology loops.		
31.	Should support a mechanism to prevent edge devices not in the network administrator's control from becoming Spanning Tree Protocol root nodes.		
32.	Switch should support static ARP, Proxy ARP, IP source guard.		
33.	Switch should have a console port with RS-232 /RJ-45 Interface for configuration and diagnostic purposes.		
34.	Switch should be SNMP manageable with support for SNMP Version 1, 2 and 3.		
35.	Switch should support all the standard MIBs (MIB-I & II).		
36.	Switch should support TELNET and SSH Latest Version		
37.	Switch should support RMON (history, statistics, alarm and events).		
38.	Switch should support system and event logging functions as well as forwarding of these logs to multiple syslog servers.		
39.	Switch should support on-line software reconfiguration to implement changes without rebooting. Any changes in the configuration of switches related to Layer-2 & 3 functions, VLAN, STP, Security, QoS should not require rebooting of the switch.		
40.	Support for Automatic Quality of Service for easy configuration of QoS features for critical applications.		

SL. No.	Minimum Requirement Description	Compliance (Yes / No)	Deviations / Remarks
Make			
Model			
41.	Support to detect unidirectional links caused by incorrect fibre-optic wiring or port faults and disable on fibre-optic interfaces		
42.	Switch should have comprehensive debugging features required for software & hardware fault diagnosis.		
43.	Should support DHCP Server feature to enable a convenient deployment option for the assignment of IP addresses in networks that do		
44.	DHCP servers configured on servers and integrated with Directory Services.		
45.	Switch should support Multiple privilege levels to provide different levels of access.		
46.	Switch should support NTP (Network Time Protocol)		
47.	Switch should support FTP / TFTP		
48.	RoHS Compliant.		
49.	IEEE 802.1x support.		
50.	IEEE 802.3x full duplex on 10BASE-T and 100BASE-TX ports.		
51.	IEEE 802.1D Spanning-Tree Protocol.		
52.	IEEE 802.1p class-of-service (CoS) prioritization.		
53.	IEEE 802.1Q VLAN.		
54.	IEEE 802.3u 10 BaseT / 100 Base Tx / 1000 Base Tx.		
55.	Switch / Switch's Operating System should be tested and certified for EAL 2 /EAL3 / NDPP or above under Common Criteria Certification		

10.1.13 Internal and External Firewall

Sl. No	Parameter	Required Specifications	Compliance (Yes/No)	Comments /Datasheet Reference
Make				
Model				
1	Firewall	The Proposed Firewall Vendor should be in the Leaders' / Challengers'' Quadrant of the latest Gartner Magic Quadrant for Enterprise Firewalls		
2		Firewall appliance should be supplied with at least 12 x 1GE interfaces and 4 x 10G SFP+ SR interfaces		
3		Firewall Throughput should be at least 50 Gbps		
4		Firewall should have IPSec throughput of 20 Gbps		
5		Firewall should support 250,000 new sessions per second		
6		Firewall should support 10 Million concurrent sessions		
7		Firewall should support 1000 site-to-site VPN tunnels & 2000 Client to Site VPN tunnels		
8		The Firewall solution should support NAT64, DNS64 & DHCPv6		
9		The proposed system shall be able to operate on either Transparent (bridge) mode to minimize interruption to existing network infrastructure or NAT/Route mode. Both modes can also be available concurrently using Virtual Contexts. Minimum 10 Virtual Firewall licenses to be provided with the solution		
10		The physical interface shall be capable of link aggregation, otherwise known as the IEEE 802.3ad standard, allows the grouping of interfaces into a larger bandwidth 'trunk'. It also allows for high availability (HA) by automatically redirecting traffic from a failed link in a trunk to the remaining links in that trunk.		
11		The proposed system should have integrated Traffic Shaping functionality.		
12		The Firewall should have integrated SSL VPN solution to cater to 5000 SSL VPN concurrent users.		
13		The Firewall & IPSEC VPN module shall belong to product family which minimally attain Internet Computer Security Association (ICSA) Certification.		
14		The proposed system should support		
15		a) IPSEC VPN		
16		b) PPTP VPN or PPTP ALG		
17		c) L2TP VPN		

Sl. No	Parameter	Required Specifications	Compliance (Yes/No)	Comments /Datasheet Reference
Make				
Model				
18		d) SSL VPN		
19		The device support inbuilt hardware VPN acceleration		
20		Intrusion Prevention System		
21		The IPS capability shall minimally attain NSS Certification		
22		The Next Generation Firewall (FW + AVC + IPS) throughput should be at least 5 Gbps for Mix / Real world traffic		
23		The IPS detection methodologies shall consist of:		
24		a) Signature based detection using real time updated database		
25		b) Anomaly based detection that is based on thresholds		
26		The IPS system shall have at least 10,000 signatures		
27		In event if IPS should cease to function, it will fail open by default and is configurable. This means that crucial network traffic will not be blocked and the Firewall will continue to operate while the problem is resolved		
28		IPS solution should have capability to protect against Denial of Service (DOS) and DDOS attacks. Should have flexibility to configure threshold values for each of the Anomaly. DOS and DDOS protection should be applied and attacks stopped before firewall policy look-ups.		
29		IPS signatures should have a configurable action like terminate a TCP session by issuing TCP Reset packets to each end of the connection, or silently drop traffic in addition to sending an alert and logging the incident		
30		Signatures should a severity level defined to it so that it helps the administrator to understand and decide which signatures to enable for what traffic (e.g. for severity level: high medium low)		
31		Antivirus		
32		The threat prevention (FW + AVC + IPS + Antivirus /Antimalware) throughput should be at least 4 Gbps on Mix / Real world traffic		
33		The proposed system should be able to block, allow or monitor only using AV signatures and file blocking based on per firewall policy based or based on firewall authenticated user groups with configurable selection of the following services:		

Sl. No	Parameter	Required Specifications	Compliance (Yes/No)	Comments /Datasheet Reference
Make				
Model				
34		HTTP, HTTPS, SMTP, SMTPs, POP3, POP3s, IMAP, FTP etc		
35		The proposed system should be able to block or allow oversize file based on configurable thresholds for each protocol types and per firewall policy.		
36		Application Control		
37		The proposed system shall have the ability to detect, log and act against network traffic based on over 3000+ application signatures		
38		The application signatures shall be manual or automatically updated		
39		The administrator shall be able to define application control list based on selectable application group and/or list and its corresponding actions		
40		Data Leakage Prevention		
41		The proposed system shall allow administrator to prevent sensitive data from leaving the network. Administrator shall be able to define sensitive data patterns, and data matching these patterns that will be blocked and/or logged when passing through the unit.		
42		High Availability		
43		The proposed system shall have built-in high availability (HA) features without extra cost/license or hardware component		
44		The device shall support tasteful session maintenance in the event of a fail-over to a standby unit.		
45		High Availability Configurations should support Active/Active or Active/ Passive		
46		Logging & reporting		
47		A dedicated appliance with 8 TB storage to be proposed with the solution for logging, analysis, and reporting into a single system, delivering increased knowledge of security events throughout the network for centralized security event analysis, forensic research, and reporting		

10.1.14 Rack Mountable TFT with IP based KVM switch

Sl. No.	Minimum Requirement Description	Compliance (Yes / No)	Deviations /Remarks
Make			
Model			
	IP Based KVM Switches		
1	It should have maximum of 16 ports with 2 remote users concurrency.		
2	It should support minimum of one local user at each switch.		
3	It should take control of servers at BIOS Level		
4	It should facilitate both in-band & out-of band access.		
5	Same switch should also support connecting serial devices with RS232 interface through different interface adaptor.		
6	Serial session launched through KVM switch shouldn't be considered as a digital path.		
7	Switch should support direct telnet/SSH access to serial devices.		
8	Remote console level access of both Servers and serial devices such as routers. Serial adaptor should support supports SSH connections pin out to make connections to Cisco equipment quick and easy without the need for any additional external wiring adapters or special wiring.		
9	Should support IPV6		
10	It should have facility to integrate with secure management devices. It should support Virtual media enables remote USB connections and support for smart card/CAC readers.		
11	Shall have 2 gigabit Ethernet ports and support 10/100/1000Mbps.		
12	Virtual Media Support of multiple media including .iso image files		
13	Shall have redundant power supplies installed.		
14	Switch should have more than one Cooling Fans.		
15	19 inch rack mountable design.		
16	Browser based Management' for both remote and local using standard browsers on Windows and/or Linux.		
17	Should support display resolution of 1600 X 1200 or better at remote.		
18	Single window access to all the equipment connected to the switch, equipment access logs, and event history and should send email alerts based on log details as triggers.		
19	Absolute mouse synchronization.		
20	To connect all the ports of the supplied KVM switches to servers / network elements, the required cables / accessories should be provided.		
21	The connectivity between the KVM and servers should be UTP using a compatible server interface module with dual USB and has to support BIOS level virtual media.		
22	Compliance from Approved Agency: UL, FCC, cUL, CE, VCCI,C-Tick, CB		
	Specs for LCD console tray		

Sl. No.	Minimum Requirement Description	Compliance (Yes / No)	Deviations /Remarks
Make			
Model			
1	LCD Panel size should be 18.5 inch diagonal		
2	Rack mountable in a 19" (1U) system rack		
3	Display area should be 409.8 x 230.4 mm (horizontal x vertical)		
4	Panel type should be TFT active matrix.		
5	Should support brightness 250 cd /m2.		
6	Should support contract ratio 1000:1.		
7	Should support 16.7million colours.		
8	Should support max resolution 1600 x 1200 at 60 Hz suitable for connection with KVM.		
9	It should support only VGA and USB connection to target computer or KVM.		
10	Operating temperature should be 0°C to 50°C		
11	Operating Humidity should be 10% to 80%		
12	Operation Altitude should be 0 to 10,000 Feet		
13	It should have 103 key keyboard with numpad and touchpad.		
14	It should have cable management arm(CMA).		
15	It should have control buttons on the front of the monitor to adjust the characteristics of the image that is displayed.		
16	It should have Two independent USB 2.0 compliant pass through ports at front side.		
17	It should be global certified by agencies UL, CE, CCC, BSMI, C-Tick, EAC, VCCI, KCC, FCC, Class A		
	Centralized Console Management System.		
1	The management software should provide unified, secure access to KVM, serial and power ports of Data Centre devices via a Web browser.		
2	The centralized management software should be installed on dedicated Physical or virtual server having specific operating system providing the administrator to put restrictions onto the server as per policies and manage it.		
3	It should support installation on 64-bit Operating System.		
4	The software should work have open editable database.		
5	Centralized management software should provide “Hub and Spoke” architecture allows for high availability and distributed access across locations. Hub and spoke architecture based solution for failover and replication of management database across locations both being on Active-Active mode.		
6	It should provide policy and security based management of users and devices connected to KVM, IPDUs		
7	It should be able to assign specific node access to a specific user.		

Sl. No.	Minimum Requirement Description	Compliance (Yes / No)	Deviations /Remarks
Make			
Model			
8	It should allow the administrator to access, manage and view all equipment, users and access permissions from a single remote device.		
9	It should be able to integrate and manage the Virtual infrastructure.		
10	Should allow to integrate the RDP, VNC viewer, telnet and SSH services to access the target servers and network appliances over IP.		
11	The Management software should natively integrate with ESX servers, Virtual Center, Citrix Xen Servers, Microsoft Hyper-V and provide the ability to manage them. It should provide a federated view of the virtual servers		
12	The system should easily integrate with the existing security infrastructure, authenticating against our internal or external standards-based services. Integration with LDAP, NT /AD, TACACS+, RADIUS and RSA Secure ID is required		
13	It should support Virtual Media Deny, View and Control access policies. Centralized management software will provide Access Control List (ACL) and role segmentation for target equipment including Virtual media access to individual server.		
14	Should be able to create unlimited users and allow a minimum of ten concurrent users.		
15	It should log user activities (login/logout, connect/disconnect), configuration changes at both appliance and managed devices, and status changes of the connected appliances. All of these logs should be forwarded to a network management system or enterprise notification system via SNMP or Syslog.		
16	Shall have security features that enable integration with Active Directory or any other external authentication tools.		
17	Flexible session time-outs.		
18	It should allow: TCP/IP, HTTP/HTTPS, SSL, DNS, and LDAP/LDAPS through network interfaces.		
19	It should be able to do Auto-discovery with devices connected for their availability status, and alarms.		
20	Shall have flexible logging and reporting options with audit trails for diagnostics and troubleshooting.		
21	Should support FIPS 140-2 appliance compliance and 2048 SSL Certificate.		
22	Shall support viewing and management of active user sessions and active ports in real time.		
23	Shall support authentication mechanism in active-active mode on a hub and spoke architecture.		
24	Should allow clients with all standard operating systems like Internet Explorer, Mozilla Firefox, Google Chrome.		

10.2 Annexure – 2: Data Center /DCC facility

Scope of Work for the System Integrator under this project would be as follows: The DC facility project is divided into 5 phases as under

1 Initiation
2 Design
3 Procure & Supply
4 Implementation
5 FAT and ISAT

Subsequently the SI shall refer to the existing layout diagram and could submit the diagrams as follows:

1 Basic Layout taking the Data Center
2 Access Control System Layout
3 Aisle Containment
4 Electrical layout
5 Lighting Layout
6 Internal/ sectional elevation
7 Cabling Layout
8 CCTV Layout
9 Fire detection system Layout
10 Water Leak Detection System layout
11 DG foundation Layout
12 PAC Piping Layout
13 Cable trench Layout
14 Coordinated Drawing of all systems inside and outside

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 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.

10.2.1 General requirement

The data center is the foundation for IT and SCADA system, to provide the basic power, cooling and racks system for the IT infrastructure，the data center should meet the Uptime Tier III design and TIA942-B, and the bidder should meet:

Basic technical requirements as follows:

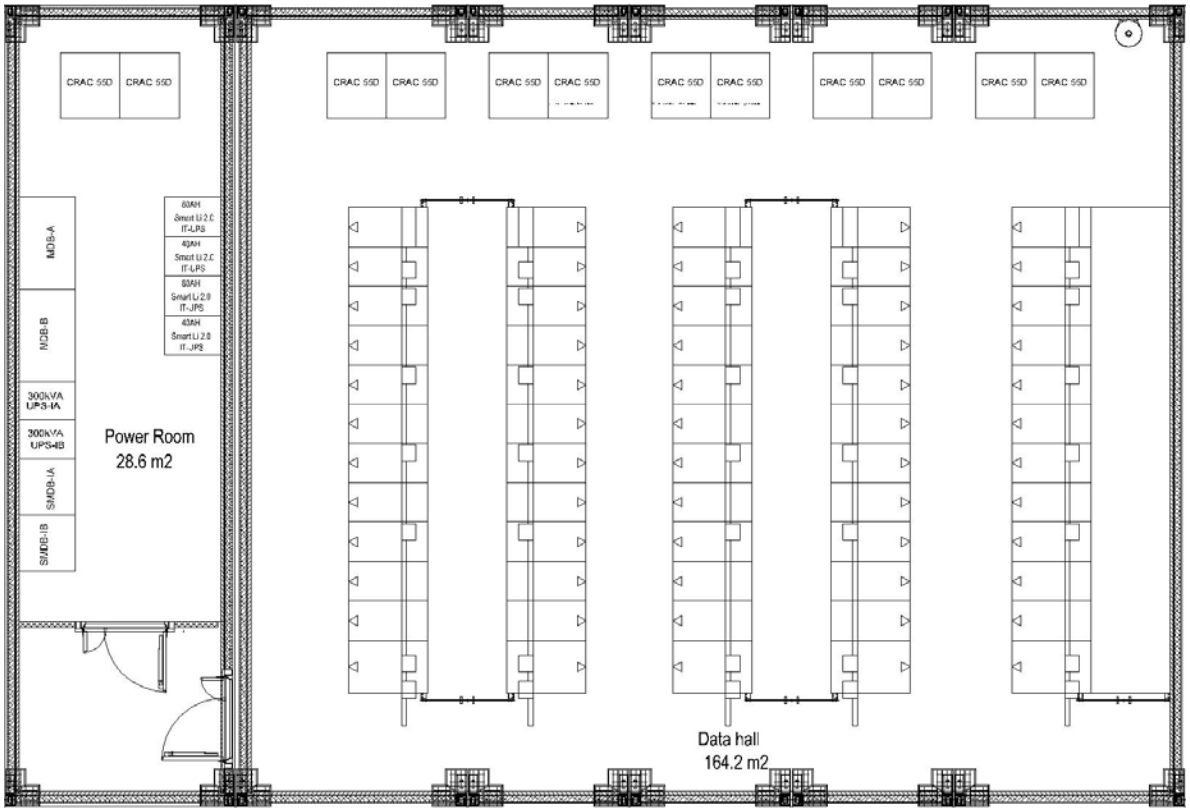
Total 60racks, 55IT racks, 5 network racks, each IT racks power design for 4kW, network rack 2kW;

2N power supply system, module UPS with hot-swappable power module;

Backup time 30 mins for battery at full load.

Containment for module data center, hot and cold aisle containment separated hot & cold air in datahall to improve cooling Efficiency.

In-room cooling air conditioner with N+1 redundancy



Data center layout

10.2.2 Electrical System

1 Detail site survey by bidder for the existing electrical installation.
2 Two utility power supply path A & B for data center, including RMU and transformer.
3 Supply and installation of Diesel generator and creating exhaust stack as required by the site authorities.
4 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 from the substation to the DC power room though trench, ladder and cable trays as suitable as per the site conditions.
7 Supply and installation of all other panels and DBs for ACs, lighting and raw power.
8 Supply and installation of Cabling and wiring for the entire site as per the design requirements.
9 Supply and installation of Earthling 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 ISAT.

10.2.3 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

10.2.4 Rack and containment system

1) Total 60 racks, 55 IT racks ,5 network racks
2) Hot aisle containment with skylights and accessories
3) Sliding doors and access control for containment
4) Rack PDU

10.2.5 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.

10.2.6 Other Items

1) Generator system
2) 42U racks with intelligent PDUs and Rack access control
3) Video wall system in NOC with controller.
4) Passive Network cabling as per TIA latest standard.
5) Periodic health Audit and preventive maintenance of the infrastructure
6) Uptime Tier III certification

10.2.7 Technical Specifications

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 provide 30 minutes system backup time
- The lithium battery support old and new battery mixed used；the same brand with UPS
- 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.

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 55kW 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 hall and N+1 redundancy for power room.
- A/C is equipped with high efficiency variable frequency compressor.

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

Width: 1200mm; Height: 2000mm

Rack

Standard 19 inch rack for 42 U, Dimension:600*1100*2000 mm for IT rack ,800*1100*2000mm for network rack ; Ventilation Rate of Front and Rear Door no less than 70%,static load no less than 1500kg;with monitor rack PDU for each rack ,

Lighting System

An intelligent lighting system is installed in the data center, DCC office area, corridor aisle, and staircase and other areas. The lights shall be controlled thru. 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.

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 Data 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.

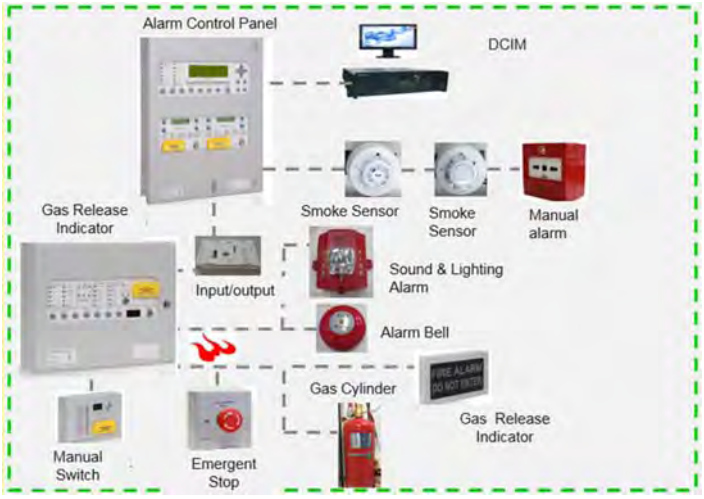
The fire extinguishing system consists of the automatic fire alarm system, automatic gas extinguishing system, emergency lighting and evacuation system, automatic water sprinkler system, hand-held fire extinguisher, fire hydrant, fire pump, and water tank.

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.	
4	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.)	
5	Zones/individuals detectors in the same loop shall be able to be set at different sensing levels and shall possible to be changed through programming at any time.	
6	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.	
7	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.	
8	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.	
9	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.	
10	Modular addition facility shall be available in the Fire Alarm Panel for future additions of loops and devices.	
11	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.	
12	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 data center and DCC 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, startup controller, pneumatic switch, and electrical actuator are all connected to the control panel for fire control and management.

Figure 1-3 Architecture of the addressable fire extinguishing system



Note: The figures provided above are for reference and tender purpose. The bidder shall include the technical features of their product with the bid.

System Operation Modes

The fire extinguishing system of the prefabricated data center shall have smoke detector and heat detector that use the double-loop alarm and control method. The fire extinguishing system shall supports automatic and manual operation modes and has the emergency start/abort switch used to manually operate the system in the case of emergencies.

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

Sl. No	**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%).	

Sl. No	**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 maintained good aesthetic view.	
4.	The entire FAS shall be intelligent analogue 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 annunciated 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.	

Sl.No.	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 loops 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.	

Sl.No.	**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**
	Sound Level	90 dB (A)	
	Function Test	Possible from FACP	
	Strobe Light	High intensity light from LED	
	Tone adjustability	Yes	
	Powering	By FACP	
	Intelligent Feature	Integral Microprocessor	
	Type	Press Glass, double action	
	Cover	Transparent protective flip cover in unbreakable type polycarbonate.	
	Reset	Directly from panel	
	Color	Red	
	Powering	By FACP	
	Parameter	**Repeater panel**	**Compliance YES/NO**
	Display	5.7" TFT colour plain text display	

Technical Specification of MCP			Compliance YES/NO
	Network	Networkable with another repeater panel and fire alarm panel	
	Enclosure	As per manufacturer	
	Navigation	Scroll wheel OR arrows buttons	
	Powering	Through FACP-UPS	
	Parameter	**Technical Specification of Computer**	**Compliance YES/NO**
	Type	Industrial PC	
	Processor	Intel 4th generation core i3	
	Operating System	Latest Windows professional version	
	Memory	8 GB	
	Hard drives	1TB SATA HDD with one hot spare HDD with auto rebuild.	
	Graphics	HD graphics card	
	Connectivity	RS 485, USB, HDMI out, LAN	
	Monitor	22” LED monitor	
	Parameter	**Technical Specification of Cable**	**Compliance YES/NO**
	Category	FRLS	
	Conductor material	Copper	

Aspiration Smoke Detection System		
Sl. No	**Technical specifications/Requirements**	**Compliance YES/NO**
	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.	
	Difficult to access areas such as intermediate ceilings, false floors, high bay storage.	
	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. data centres, server cabinets.	
	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:	
	Power ON/OFF	
	State display	

Gas Suppression System		
Sl. No	**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: Novec 1230 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	
	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.	
	Fire Suppression Systems shall be designed for the following classes of fire:	
	Class A: Surface Type Fires—wood or another cellulose-type material	
	Class B: Flammable liquids	
	Class C: Energized electrical equipment	
	For hazards beyond the scope described above, the designer shall consult with OEM and NFPA 2001.	
	CODES AND COMPLIANCE	
	The design, installation, testing and maintenance of the Fire Suppression Systems, employing Novec 1230, shall be in accordance with the following codes, standards and regulatory bodies:	
	NFPA 2001: *Standard for Clean Agent Fire Extinguishing Systems.*	
	UL 2166: *Standard for Halocarbon Clean Agent Extinguishing System Units*	
	IS: 15493: *Gaseous Fire Extinguishing System - General Requirements*	
	IS: 15496: *Inspection and Maintenance of Gaseous Fire Extinguishing System - Code of Practice*	
	ANSI B1.20.1: *Standard for pipe threads, General Purpose, 1992*	

Sl. No	**Technical specifications/Requirements**	**Compliance YES/NO**
	NFPA 70 - NEC – *National Electrical Code*	
	NFPA 72 – National Fire Alarm Code	
	Requirements of the local Authorities Having Jurisdiction (AHJ)	
	The manufacturer shall meet ISO 9001 requirements for the design, production and distribution of the engineered fire suppression system.	
	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	
	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.	
	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	
	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	
	The OEM-authorized Distributor or OEM shall provide all required installation drawings per NFPA 2001.	
	Flow Calculation Reports	
	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:	

Sl. No	**Technical specifications/Requirements**	**Compliance YES/NO**
	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.	
	Pipe: As per ASTM A-106, Sch 40, M. S. Seamless	
	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.	
	Distribution Nozzles: Discharge nozzles shall be used to disperse the clean agent.	
	Seamless Cylinders and valve assembles: 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 IS 7285 Standard and approved by PESO for their use. 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	
	Pressure Control Operated Head: Pressure operated Control Head, should allow for Pressure actuation of Clean Agent storage Cylinders.	
	Flexible Discharge Hose & Actuation Hose	
	The Flexible Actuation Hose, should be usually used in multiple Cylinder Systems	
Access Control System		
Sl. No	**Technical specifications/Requirements**	**Compliance YES/NO**
	Access to the facility must be though 2 levels of authentication. First level at the Reception of the data centre entry through access card and Second level at the Datacentre entry door through biometric and pin pad/ contact less card access.	
	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	

Sl. No	**Technical specifications/Requirements**	**Compliance YES/NO**
	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	
	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	
	Smart card readers at every Critical door for Entry and Exit. Biometric finger print Card reader for Critical door of Server room Door only for Entry Point and exist Smart card readers	
	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	
	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.	
	All doors will have access control through pin pad and contact less readers	

CCTV System

Sl. No	Technical specifications/Requirements		**Compliance YES/NO**
	Image Sensor	1/2.9" Progressive CMOS or better	
	Maximum Resolution	1920 x 1080 (2MP)	
	Lens Type	Fixed-focal	
	Focal Length	f = 2.8 mm	
	Aperture	F1.8	
	Field of View	105° (Horizontal)	
		60° (Vertical)	
		109° (Diagonal)	

Sl. No	**Technical specifications/Requirements**		**Compliance YES/NO**
	Shutter Time	1/5 sec. to 1/30,000 sec or better	
	Day/Night	Removable IR-cut filter for day & night function	
	Min. Illumination	Color: 0.01lux (F1.4, AGC ON)	
		B/W : 0.004lux (F1.4, AGC ON)	
		0 lux with IR on	
	Pan/Tilt/Zoom Functionalities	ePTZ:	
		48x digital zoom (4x on IE plug-in, 12x built-in)	
	IR Illuminators	Built-in IR illuminators, effective up to 20 meters or better	
		with Smart IR	
		IR LED*8	
	On-board Storage	MicroSD/SDHC/SDXC card slot	
		Seamless Recording	
	Video		
	Compression	H.264 & MJPEG	
	Maximum Frame Rate	30 fps@ 1920x1080 in both compression modes	
	Maximum Streams	4 simultaneous streams or better	
	S/N Ratio	65 dB	
	Dynamic Range	65 dB	
	Video Streaming	Adjustable resolution, quality and bitrate	
	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		
	Users	Live viewing for up to 10 clients	

Sl. No	Technical specifications/Requirements		**Compliance YES/NO**
	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	
	Interface	10 Base-T/100 Base-TX Ethernet (RJ-45)	
	ONVIF	Supported	
	Intelligent Video		
	Video Motion Detection	Five-window video motion detection	
	Alarm and Event		
	Alarm Triggers	Motion detection, manual trigger, periodical trigger, system boot, recording notification, camera tampering detection	
	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		
	Connectors	RJ-45 for Network/PoE connection	
	LED Indicator	System power and status indicator	
	Power Input	IEEE 802.3af PoE Class 0	
	Power Consumption	Max. 9 W	
	Safety Certifications	CE, LVD, FCC Class B, VCCI, C-Tick	
	Operating Temperature	Starting Temperature: 0°C ~ 50°C (32°F ~ 122°F)	
		Working Temperature: -10°C ~ 50°C (14°F ~ 122°F)	
	Humidity	0.9	
	Network Video recorder		
	OS	Embedded Linux	

Sl. No	Technical specifications/Requirements		Compliance YES/NO
	Flash	256 MB	
	RAM	2 GB	
	Watchdog	Hardware + Software	
	Power Restoration	System Restart Automatically after Power Recovery	
	Storage	-	-
	HDD Devices	Internal x 2	
	HDD Max. Capacity	8 TB x 2	
	Disk Management	Create, Format and Remove Disk, HDD S.M.A.R. T	
	Video	-	-
	Video Output	HDMI x 1, VGA x 1	
	Resolution	1920 x 1080, 1280 x 720	
	Graphics Decoder	Hardware decoding	
	Decoding Capacity	H.264:	
		2560 x 1920 @ 30 fps (1-CH) 1920 x 1080 @ 120 fps (4-CH)	
		1280 x 720 @ 240 fps (8-CH) 720 x 480 @ 480 fps (16-CH)	
	Camera Position	Change the view cell position on the Live View screens	
	External Interface	-	-
	USB Interface	Front: 2 (USB 2.0), Back: 1 (USB 2.0)	
	Alarm In	8	
	Alarm Out	4	
	Audio	1 x 3.5 Phone Jack Audio Output 1 x 3.5 Phone Jack Audio Input (Reserved)	
	External HDD	1 x east Port	
	RS232	1 Port (Reserved)	

Sl. No	Technical specifications/Requirements		Compliance YES/NO
	RS485	1 Port (Reserved)	
	Network	-	-
	Network Interface	10/100/1000 Mbps Ethernet (RJ-45) x1	
	PoE	8x 802.3af Compliant PoE Ports (Total Max. 80 W)	
	Protocols	IPv4, TCP/IP, HTTP, HTTPS, UPnP, RTSP/RTP/RTCP, SMTP, FTP, DHCP, NTP, DNS, DDNS, IP Filter	
	LED Indicator	-	-
	LED Indicator	Power, Status, Record, HDD1, HDD2, eSATA, Ethernet, Port1~Port8	
	Mechanic	-	
	Operating Temperature	0°C ~ 40°C (32°F ~ 104°F)	
	Humidity	0 ~ 95%	
	Client PC Requirements	-	
	Operating System	Microsoft Windows 10 or latest	
	CPU	Intel i5 or better	
	Memory	16 GB or above	
	Ethenet	10/100 Mbps	
	Display Resolution	1024 x 768 pixels or above	
	Web Browser	Internet Explorer 10 (32 bit) or above	
	Software AP	Installation Wizard 2, ST7501, VAST	
	Mobile/Tablet App	Support iOS/Android	
	Accessories	-	
	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	-	
	Maximum Channel	16	
	Record Throughput (MB)	96 Mbps	
	Network Throughput (MB)	24 Mbps	
	Audio Format	G.711, G.726	
	Video Format	MJPEG, H.264	
	Video Resolution	VGA, 1MP, 2MP, 3MP, 5MP & 12MP Camera	
	Array Type	RAID 0, 1	
	Recording Time (sec.)	Pre-Record: 5 (max. 10)	
		Post-Record: 20 (max. 300)	
	Recording Stream	Single	
	Recording Mode	Continuous, Schedule, Manual, Event,	
		Activity Adaptive Streaming	
	Recording Setting	Recycle (unit: Day)	
	Recording Path	Local Path	
	Record Video Format	3GP	
	Monitor Enhancement	OSD Display (NVR), OSD Display (Camera), Camera Information, Remote I/O Control, Event Notification, Aspect Ratio	
		Fisheye Dewarp: 1O,1P,1R,1O3R,1O8R	
	PTZ Control	Panel Control	
	PTZ Operation	Direction Control, Home, Iris, Preset, Patrol (Group), PiP Control	
	Playback (Local Display)	-	
	Playback Display	4 Channels	

		Multiple Layout Display: 2x2	
	Playback Control	Regular (Play, Pause, Stop), Rewind, Next / Previous Frame, Speed Control, Calendar, Event, Timeline, Timeline Scale, Thumbnail (Storyboard)	
	Video Search	By calendar, date/time, and alarm	
	Thumbnail Explorer (Storyboard)	Listing the thumbnail of recorded video (Max. 2 CH)	
	Monitor Enhancement	OSD Display (Camera), Event Notification, Aspect Ratio, PiP Control, Fisheye Dewarp (1O,1P,1R,1O3R)	
	Snapshot	JPEG	
	Video Clip Export	EXE	
	LiveView (Remote)	-	
	Stream Application	Stream Selection	
	Audio Capability	One Way	
	LiveView Display	16 Channels	
		Multi Layout display:	
		1x1, 2x2, 3x3, 4x4, 1+3, 1+5, 1+12	
	Monitor Enhancement	OSD Display (NVR), Drag & Drop, Image Freeze, Audio Control, Remote I/O Control, Event Notification, Bookmark, Fisheye Dewarp (1O, 1P, 1R)	
	PTZ Control	Panel Control	
	PTZ Operation	Direction Control, Home, Zoom, Focus, Iris, Preset, Patrol (Group), PiP Control	
	Snapshot	JPEG	
	Playback (Remote)	-	
	Playback Display	4 Channels	
		Multi Layout display:	
	Alarm Management	-	
	Schedule Type	Continuous, Schedule, Manual	

Sl. No	Technical specifications/Requirements		Compliance YES/NO
	Event	Motion Detection, PIR Detection, Tampering Detection, Digital Input (Camera), Digital Output (Camera), Connection Abnormal, Storage Abnormal, Storage Full, Camera Network Loss, DI, DO	
	Action	Record, Email (Text), Email (Snapshot), FTP, Buzzer, PTZ Control (Go to Preset), NVR DO, Camera DO	
	Recording Time (sec.)	Pre-Record: 5 (max. 10), Post-Record: 20 (max. 300)	
	Backup	-	
	Manual	USB Dongle (FAT Format)	
	System		
	User Management	User Account: 16 User	
		Account Time Limit: 10 mins	
		User Level: Administrator / Regular User	
		User Feature Definition: By Camera	
	Log	System, Recording, User, Error	
	Date&Time	Time Zone, Manual, Automatic Sync NTP, Daylight Saving Time	
	Firmware	Manual update	
	Restore Default	To be Supported	
	Backup/Restore (Configuration)	To be Supported	
	Camera Integration	-	
	Insert Camera	Manual, Search	
	Video (Media) Setting	Compression, Resolution, FPS, Video Quality	
	Image Setting	Image Display Image Adjustment	
	PTZ Control	Panel Control	
	PTZ Operation	Direction Control, Home, Preset, Patrol (Group)	
	Motion Detection	Supported	

	ONVIF Stream	Video (H.264 & MJPEG)	
	ONVIF Recording	Continuous, Schedule, Manual	
	Rodent Repellent system		
	Panel Specification		
	· Configuration: URRS - 12T Main Console		
	· Operating frequency: Between 20Khz to 50Khz auto sweep		
	· Frequency Generation: Voltage controlled oscillator (VCO)		
Sl. No	Technical specifications/Requirements		**Compliance YES/NO**
	· Transducer Test: “Test Transducer” Menu selection		
	· Ventilation: Mini Exhaust Fan		
	Transducer Specification		
	· Ultrasound Generator: Piezo Electric disc type transducer		
	· Power O/P Transducer: minimum 800mW		
	· Sound Pressure: 80dB to 110dB (At 1 meter)		
	· Transducer Housing: ABS Plastic with mounting base		
	Water leak Detection System		
	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.		
Sl. No	Technical specifications/Requirements		**Compliance YES/NO**

Sl. No	Technical specifications/Requirements	**Compliance YES/NO**
	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 do 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.	
DATA CENTER INFRASTRUCTURE MONITORING SYSTEM		
Sl. No	**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.	

Sl. No	Technical specifications/Requirements	**Compliance YES/NO**
	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 pin point problems through this solution.	
	j) The solution shall support all levels of role based access control and fine grain authorization for each functional department.	
	The DCIM system should be open, ecological, and modular.	
	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.	
	"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%;	
Sl. No	Technical specifications/Requirements	**Compliance YES/NO**

Sl. No	Technical specifications/Requirements	**Compliance YES/NO**
	The system must provide a centralized monitoring page in a unified style and provide 3D visual interface, link topology, and temperature map.□ Provides a 3D model for devices in the data center, such as air conditioners, UPSs, cabin	
	The system must accurately manage all alarms of the entire data center, 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.	
	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.	
	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 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. All log data cannot be modified, and logs can be queried and exported.	
	ELECTRICAL SYSTEM	
Sl. No	**Technical specifications/Requirements**	**Compliance YES/NO**
	STANDARDS AND CODES	
	Updated and current. Standard Specifications and Codes of Practice will apply to the equipment and the work covered by the scope of this contract	
	Low Voltage Switchgear Assemblies IEC61 439-1 & 2	
	Low Voltage switchgear & control gear	
	EC 60 947 /IS 13947: 1993	
	Part I: General rules	
	Part II: Circuit Breakers	
	Part III: Switches, disconnectors, switch disconnectors and fuse combination units	
	Part IV: Contactors and Motor starters	
	Part V: Control circuit devices and switching elements	
	Degree of Protection of Enclosures for low voltage switchgear. IEC60529 /IS 2147: 1962 Internal arc – IEC 61641 V2	

	Degree of Protection of Enclosures for low voltage switchgear. IEC60529 /IS 2147: 1962	
	Internal arc – IEC 61641 V2	
Sl. No	Technical specifications/Requirements	**Compliance YES/NO**
	SWITCHBOARDS	
	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.	
	The designs of the switchboards should be with switchgear manufacturer, and all the mechanical drawings must be available in the factory beforehand.	
	Only OEM design model panels shall only be supplied.	
	Switchboards shall have a short circuit level withstand as per Schedule of Quantities and drawings.	
	Panel shall be tested of design as per Seismic Zone 4 of IEC 60068-3-3 requires compliance against 0.4g acceleration	
	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.	
	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.	

	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.	
	The switchboard along with ACBs and connections should have been being type 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	
Sl. No	Technical specifications/Requirements	**Compliance YES/NO**
	Panel shall be rated for Impulse withstand capability equal to or greater than the switchgears inside the panel i.e. 12kV	
	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	
	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	
	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	
	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 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 GI earth strip of required size with 2 nos 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 415V 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.	
	All Panel/Switchboards shall have provision for entry of cables from the top and bottom as required.	
	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.	
	All meters shall be digital type with LED display.	
	Operations Logic to be decided and approved by NEA before GA drawing submission by bidder.	
Sl. No	Technical specifications/Requirements	**Compliance YES/NO**
	Incomer:	
	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:	
	2 Sets of R, Y, B Phase Indicating lamps with Neutral link with control MCB. (3x2A).	
	ON-OFF-TRIP indication lamps with control MCB (3x2 A)	
	Multi-function Meter (equivalent to EM 6400) with CT -800/5A, 15VA, CL-1.0.	
	BUSBAR SECTION:	
	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 1.5Amps/Sqmm. Neutral bar shall be of the same size as phase bar.	
	Metering, Indication & Protection:	
	ON-OFF-TRIP and all phase with neutral indication lamps with control MCB (3x2 A)	
	Tie Breaker:	

	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.	
	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	
	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	
	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	
	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	
	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	
	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	
	Busbar AL 300A	
	Metering, Indication & Protection:	
	1 Set of R, Y, B Phase Indicating lamps with Neutral link with control MCB. (3x2A)	
	ON-OFF-TRIP indication lamps with control MCB (3x2 A)	
	Multi-function Meter (equivalent to EM 6400) with CT -300/5A, 15VA, CL-1.0	
	Outgoing	
	6 nos 63A 4 pole MCB	
	4 nos 32A 2 pole MCB	

Sl. No	Technical specifications/Requirements	**Compliance YES/NO**
	APFC PANEL: Minimum value provided. The qty. may vary during DDE.	
	GENERAL	
	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 nos 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.	
	All Panel/Switchboards shall have provision for entry of cables from the top and bottom as required	
	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	
	All kA values indicated shall be Ices breaking capacity.	

	APFC Control Circuit Stage load based	
	Incomer 160A 4P MCCB 25kA CCB with thermal overload, magnetic short circuit release and	
	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	
	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 415 volts. The neutral busbar is to be of 100% capacity.	
	Indicators	
	3 Phase (R, Y, B Indicator lamps with control MCB)	
	ON/OFF/Trip Indication (R, Y, An Indicator lamps with control MCB)	
	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 in to consideration	
	The Switchboard shall be extensible complete with all interconnections, risers, internal wiring, labels etc complete as required 3 phase load based sensor and switching	
	1 set of Red/Green Indicating lamp to give status of the circuit Each Capacitor	
	1 set of manual ON/OFF push buttons	
	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.	
	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	

	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	
	The conductors shall be made from high conductivity copper rods complying with IS: 613-1964. 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. Cable Joints: 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,	
Sl. No	Technical specifications/Requirements	**Compliance YES/NO**
	Cable Joints:	
	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 wire in the conductor (number of strands) as given in IS 8130 (Part I): 1984.	
	Insulation	
	The insulating material for power cables shall be extruded cross linked polyethylene (XLPE) compound as per IS-7098(Part-I)-1988. The minimum thickness of insulation shall not be less than the values specified in Table-2 of IS-7098 (Part-I)- 1988. 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	

	The inner sheath shall be extruded FRLS PVC, Type ST2, compatible with thermal rating of insulation conforming to IS-6380-1984. The sheath shall have adequate thickness, mechanical strength and elasticity. The material shall be soft thermoplastic type, applied by extrusion method.	
	Armouring	
	The armouring arranged over the inner sheath shall consist of one layer of galvanized round steel wires for all sizes of cable..	
	Outer Sheath	
	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 to IS 1554/ IS 5831 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.	
Sl. No	Technical specifications/Requirements	**Compliance YES/NO**
	Light fixtures complete with Energy Efficient Electronic Ballast, Control gear and all the other standard accessories.	
	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	
	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,	
	UPS Body earth	
	UPS neutral earth	
	DG body earth	
	DG neutral earth	
	Electrical Panel Body earth	
	Tray earth o Rack body earth	

	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.	
	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.	
	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.	
	POINT WIRING: FOR LIGHT FIXTRURES: 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.	
Sl. No	Technical specifications/Requirements	**Compliance YES/NO**
	(SWITCHES & SOCKETS SHALL BE OF MODULAR TYPE)	
	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).	
	32A, 415V, 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)	
	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	
	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	

	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	
	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	
	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	
	Each cable and GI/MS conduit run shall be tagged with numbers that appear in the cable and GI conduit schedules.	
	Cables and GI/MS conduits shall be tagged at their entrance, every 30.0M and exit from any equipment, junction box	
Sl. No	Technical specifications/Requirements	**Compliance YES/NO**
	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	
	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	
	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**

	UPS for Critical load: For Data Centre IT Load, the Bidder should provide 2 nos. (N+N) UPS (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	
	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.	
	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.	
	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.	
Sl. No	Technical specifications/Requirements	**Compliance YES/NO**
	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.	
	The scope should include supply, transportation, storage, unpacking, erection, testing, successful commissioning and satisfactory completion of trial operations of the 300 kVA/kW UPS in N+N Configuration systems for Datacentre. The UPS should be scalable to minimum 300 KW/KVA by adding additional UPS modules in the one or multiple frames.	

	Each UPS should have Hot swappable/trained-user replaceable Minimum 30 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/trained-user-replaceable battery modules should be provided along with UPS.	
	AC Input Voltage Window:	
	±15 percent for full performance (340 to 460 volts at 400 volts)	
	Operating ambient temperature: 0°C to 40°C	
	Input Power Factor:	
	1) Greater than 0.99 with load at 100 percent.	
	2) Greater than 0.98 with loads above 50 percent.	
	3) Greater than 0.97 with loads above 25 percent.	
	Relative humidity: 0 to 95%, non-condensing.	
	Operating altitude with no de-rating: 0 to 1000m feet above sea level.	
	Overload Rating:	
	1) **Normal Operation:**	
	a) 150 percent for 60 seconds before transfer to bypass.	
	b) 125 percent for 10 minutes before transfer to bypass.	
Sl. No	Technical specifications/Requirements	**Compliance YES/NO**
	2) **Battery Operation:** 125 percent for 30 seconds (up to 10 minutes with fully configured battery solution)	
	3) **Bypass Operation:**	
	a) 110 percent continuous at 400 volts.	
	b) 170% percent for 10 Minutes	
	c) 1000 percent for 100 milliseconds.	

	Input power factor: 0.99	
	Input current distortion with no additional filters.	
	< 3% THD at 100% linear load	
	System AC-AC Efficiency:	
	1) Normal operation: > 95 percent at 40 percent to 100 percent load.	
	2) Battery operation: > 95 percent at 40 percent to 100 percent load.	
	Output Power Factor Rating: 0.5 leading to 0.5 lagging without any derating in kVA capacity.	
	International Electrotechnical Commission (IEC):	
	1) Low Voltage Directive: 2006/95/EC with the Amendment Directive 93/68/EEC Directive for electromagnetic compatibility 2004/108/EC	
	2) General and safety requirements for UPS used in operator access area: IEC/EN 62040-1-1 incorporating requirements of IEC/EN 60950-	
	3) Electromagnetic compatibility (EMC) requirements for UPS: IEC/EN 62040-2: Immunity category C2, Emission category C2	
	4) IEC 62040-3, “Uninterruptible Power Systems - Method of Specifying the Performance and Test Requirements	
	The UPS should have Redundant controllers	
	Modular Batteries: Should be designed for 15 Minutes back up at Full Load on each UPS.	
Sl. No	Technical specifications/Requirements	**Compliance YES/NO**
	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.	

	Battery Charge Current Limit: The UPS should can 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	
	A microprocessor controlled display unit should be located on the front of the system.	
	The display unit should allow the user to display an event log of all active alarms and most recent status and alarm events.	
	The following minimum set of alarm conditions should be available:	
	Inverter fail	
	EPO Active	
	Bypass Mode	
	Battery Mode	
	Battery Low Pre-warning	
	Source share mode	
	Battery Replaced	
	Normal Mode	
	Battery Period Testing	
	Batt. Capacity Testing	
	UPS System Testing	
	Bypass Abnormal	
	Mains Volt. Abnormal	
Sl. No	Technical specifications/Requirements	**Compliance YES/NO**
	Battery End of Discharge	
	Fan fault	
	DC Bus Over Voltage	
	DC Bus Abnormal	
	Battery over-temperature	

	Ambient Overtempt	
	Output overloaded	
	UPS system for Non-Critical Load	
	UPS (non-Modular) of 80 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.	
	IGBT based UPS with High efficiency and power quality.	
	Output Crest factor: 3:1 without derating of output.	
	Output Voltage Distortion: £ 5% for linear and Non-Linear loads;	
	Efficiency: Overall efficiency of each UPS unit shall be greater than or equal to: 94% @ full load.	
	Noise level: less than: 65 dbas.	
	Overload capacity: The UPS shall be capable of supplying for at least:	
	10 minutes @ 125% of the rated load;	
	1 minutes @ 150% of the rated load;	
	Standards	
	IEC 62040-1 and EN 62040-1: UPS - Safety.	
	IEC 62040-2 and EN 62040-2: UPS - Electromagnetic compatibility - [level C3 / C2 class A is optional].	
	IEC 62040-3 and EN 62040-3: UPS - Performance.	
	CE marking.	
Sl. No	Technical specifications/Requirements	**Compliance YES/NO**
	Smart Bus Way for IT racks (Modular)	**Compliance YES/NO**
	smart busway is flexible in configuration, easy to install,and can be expanded online, space saving, and improving the revenue of data center.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 data center.	

	Main Input Circuit Breaker	
	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 415 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	
	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	
	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	
Sl. No	Technical specifications/Requirements	**Compliance YES/NO**
	Power Monitoring System	

	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 the following parameters:	
	· 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.	
	· 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)	
	· Historical & current events	
	· Real-time waveform of source voltages and currents	
	· Real-time waveform of branch currents and voltages	
	· Energy Statistics	
	· System Reports	
	· Date	
	· Time	
	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.	
Sl. No	Technical specifications/Requirements	**Compliance YES/NO**
	Alarm Annunciation	

	The monitoring system shall detect and annunciate by audible alarm and alarm message the following conditions:	
	· Overvoltage	
	· Under voltage	
	· Phase loss	
	· Overcurrent	
	· Current exceeds high threshold limits	
	· Current exceeds low threshold limits	
	· Input frequency abnormal	
	· Branch abnormal	
	· Phase sequence reverse	
	· Neutral Overcurrent	
	· Ground Overcurrent	
	· Output Voltage Distortion	
	· Frequency Deviation	
	· Phase Sequence Error	
	· Over temperature	
	· Auxiliary power abnormal	
	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.	
Sl. No	Technical specifications/Requirements	**Compliance YES/NO**
	<u>Input Lightning/Surge Arrester</u>	

	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	
	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.	
	DIESEL GENERATOR AND ALLIED SYSTEM	
	General Requirement	
	Diesel Generator location shall be provided within the DCC building or outside, as suitable. Bidder must visit the area and the location and assess the distance from the DG to the Main LT panel that will be housed inside the data centre at first floor. The bidder shall propose the supply and installation of the exhaust pipe as per manufacturer standard, best practice and as per CPCB norms. In case an exhaust stack structure is required, the same may be quoted. The bidder shall propose the DG foundation for proposed rating as per OEM recommendation.	
	DG Set should be 625 KVA. DG should be suitable to supply power continuously to a constant or varying electrical load for unlimited hours in a data centre application. The DG should meet the uptime requirement of a Tier III data centre conforming to 2012 IBC Certification and capable to run for unlimited hours of operation. DG should can deliver Minimum 400 kWe @ 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 can either be Data Centre Continuous Rating conforming to 2012 IBC Certification and should meet uptime requirement of a Tier III data centre. The Proposed DG set capable to run for unlimited hours of operation at its full capacity for 12 hours.	
Sl. No	Technical specifications/Requirements	**Compliance YES/NO**
	Scope	

	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.	
	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:	
	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.	
	Radiator of suitable capacity coupled with the Engine.	
	Equipment’s necessary for fuel distribution including day oil tank, piping, valves, and calibrated MS tank along with level switch Flexible connections,	
	Residential type silencer, exhaust system including piping, support and thermal insulation for total exhaust system.	
	Starting batteries and battery-charging equipment, including their connections as required o Set of Anti Vibration Mountings pad etc.	
	The DG Set shall have properly machined common base frame with grouting bolts.	
	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.	
Sl. No	Technical specifications/Requirements	**Compliance YES/NO**

	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.	
	AIR CONDITIONING SYSTEM (PAC)	**Compliance YES/NO**
	The following parameters shall be maintained in the Data centre / DCC building	
	Temperature: 35 Degree C (Return Air Temperature)	
	Humidity: 50+/- 5% RH.	
	Ambient: 35 Degree C	
	The cooling for the data 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.	
	The entire system should be designed in accordance to latest guidelines of ASHRAE TC9.9.	
	The Present IT load per rack to be considered as 7 kW and 10 KW per Rack. Minimum 80-90 CFM per kW as per server requirement to be considered while proposing/designing the Cooling unit.	
	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%.	
	The system shall be designed for use with R410A refrigerant, which meets the Clean Air Act for phase out of HCFC refrigerants.	
	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.	
Sl. No	Technical specifications/Requirements	**Compliance YES/NO**

	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.	
	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	
	The filters should be minimum 30% efficient per ASHRAE Standard 52.1, UL Class 2 (MERV 8 per ASHRAE 52.2). Filters should be EN779 G4 efficient. The 3.75 in. (96 mm) deep, pleated filters should be replaceable from the rear of the unit	
	The dual-float condensate pump shall have a minimum capacity of 8 GPH (22.7LPM @9 mtr head).	
	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. 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.	
	The cooling units should have adjustable baffles to adjust the airflow direction	
	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 thanks to a standard web browser (Internet Explorer).	
	Humidifier should be able to modulate capacity. The humidifier should be self-contained, steam-generating type, factory piped and wired, with disposable cylinder and automatic solid-state control circuit. Humidifier canisters should be replaceable. The humidifier controller should communicate directly to the microprocessor controller and provide complete status and control at the operator interface. Humidifier should control flush cycling and conductivity via automated controls. Humidifier should produce up to 6.6 lbs. (3 kg) of steam per hour	
Sl. No	Technical specifications/Requirements	**Compliance YES/NO**

	Entry and Exit Doors of the Aisle should have open able or sliding double door	
	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	
	Columns should be grouted to real floor or can be fixed to the base frame of rack	
	Vertical columns should be connected to each other with help of Cross members. These Cross members should be length of Aisle width	
	The Doors must have a Steel Picture Frame fabricated in 1.2mm thick CRCA sheet as per “IS 513 Grade D” standards	
	PU Foam Gasket should use across the metal edges of the door to prevent any leakage on cold air	
	The doors should have automatic door closers installed to ensured that those are closed.	
	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 “IS 513 Grade D” with thickness of 1.2 mm. The Glass/ Polycarbonate in the top Panels are of 4 mm thick	
	Top Panel must be tool less installation to offer quick access to area above the contained aisle during the maintenance activity	
	Top Panel must have opening for Smoke Sensor/ FM System wherever necessary	
	The Powder coating complies with ROHS requirement to avoid hazardous substance contamination in the Data Centre. Pre-treatment Nano Ceramic process should be followed. The powder coating thickness is 80-100 Microns	
	Main Performance of the PAC	
	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 stepless 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 aluminum 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	
	Each PAC should have its own internally developed, advanced microprocesser controller. A PAC controller should use a 7-inch, true-color 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, undervoltage, 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 analyzed 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 color, making it easy for operations staff to check the status inside the data center. 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**
	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.	

	The condensing units should can 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	
	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. on operating envelope may be necessary. Risk of electrical disturbance to control signals	
	OUTDOOR UNIT WITH HEAT PUMP	
	The outdoor shall be factory assembled weather proof casing constructed from heavy gauge MS panels and coated with baked enamel finish of color approved by architect. The unit should be completely factory wired tested with all necessary control.	
	All ODU shall have minimum 2 Scroll Compressors and be able to operate even in case one of the compressors is out of order.	

Sl. No	Technical specifications/Requirements	**Compliance YES/NO**
	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.	
	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 contractors scope.	
	COMPRESSOR:	
	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 thru loading or unloading.	
	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.	
	ODU heater to be provided in compressor casing.	
	The inverter shall be IGBT (insulated gate bipolar transistor) type for efficient and quiet operation.	
	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 thru loading or unloading.	
	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.	
	ODU heater to be provided in compressor casing.	
	The inverter shall be IGBT (insulated gate bipolar transistor) type for efficient and quiet operation.	

	HEAT EXCHANGER	
	The heat exchanger shall be constructed with copper tubes mechanically bonded to Aluminium fins to form a cross fin coil.	
	The Aluminium fins shall be treated with anti-corrosion resin film.	
	The unit should be with E- bypass / Split type Heat Exchanger for good efficiency of condenser.	
	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	
	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.	
	INDOOR UNIT	
	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.	
	Indoor units shall be either ceiling mounted cassette type, or ceiling mounted ductable 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.	
	The address of the indoor unit shall be set automatically in case of individual and group control	
	In case of centralized control, it shall be set by liquid crystals remote Controller.	
	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.	
Sl. No	Technical specifications/Requirements	**Compliance YES/NO**

Sl. No	Technical specifications/Requirements	**Compliance YES/NO**
	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.	
	Unit shall have cleanable type filter fixed to an integrally moulded plastic frame. The filter shall be slide away type and neatly inserted.	
	Each unit shall be provided with Electronic Expansion Valve for cooling and heating.	
	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 change sin set temperature as per requirement.	
	REFERIGERENT	
	Refrigerant should be only R-410A.	
	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 or workmanship shall also be filled up free of cost during execution and guarantee period.	
	REFERIGERANT PIPING	
	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.	
	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 conti9nuously kept clean of dirt etc. while constructing the joints. Subsequently, it shall be thoroughly blown out using nitrogen.	
Sl. No	Technical specifications/Requirements	**Compliance YES/NO**

Sl. No	Technical specifications/Requirements	**Compliance YES/NO**
	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.	
	The suction line pipe size and the liquid line pipe sizes shall be selected according to the manufacturers specified outside diameter. All refrigerant pipe 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	
	Shall be UPVC.	
	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	
	The pipe shall be laid in proper slope for efficient draining of the condensate water.	
	PIPE INSULATION	
	Refrigerant Pipe Insulation:	
	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.	
	The joint shall be properly sealed with R242 adhesive of polychloroprene to ensure proper bonding at the ends.	
	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	
	Drain pipe carrying condensate water shall be insulated with 3 MM thick Kinifoam.	
	The joint shall be properly sealed with R242 adhesive of polychloroprene to ensure proper bonding at the ends.	

Sl. No	Technical specifications/Requirements	**Compliance YES/NO**
	For proper drainage of condensate U-trap shall be provided in the drain piping (wherever required).	
	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 systems (STS)		
	IT Racks, Rack Based Access Control System, rPDU, Asset Tracking	
	IT Racks	
	a. The racks should be designed to provide a secure, managed environment for server and Networking equipment.	
	b. The racks should be UL Approved and comply to EIA-310, REACH and RoHs.	
	c. Front and Back doors should be perforated with min 70% or higher perforations.	
	d. Racks should have a provision for cable entry from the top and bottom.	
	e. The racks should be available with a vertical equipment mounting space of 42U and each U position should be marked with its numbering.	
	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.	
	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.	
	h. The front and rear doors should open a minimum of 140 degrees to allow easy access to the interior.	
	i. All enclosure panels and rack-mounted equipment should be inherently earthed or grounded directly to the frame.	
	j. The racks should have a minimum of IP 20 rating for protection against touch, ingress of foreign bodies, and ingress of water.	
	k. Front and Rear rails should be fully depth adjustable.	

Sl. No	Technical specifications/Requirements	**Compliance YES/NO**
	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.	
	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 1998 mm including castor and wheels.	
	n. Network Racks should be of 800 mm wide and 1200 mm deep with caster wheels and levelling feet. Overall height of Racks should not exceed 1998 mm including castor and wheels	
	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.	
	p. The frame shall support 1361kg static weight load, 1022kg dynamic (non-transit) weight load, and 907kg transit weight load	
	q. All rack sheet metal components should be powder coated RAL7021 (Black).	
	IT Racks	
	The cabinet complies with IEC 60297-2 and is compatible with the 19" rack international standard**.**	
	The cabinet is made of high-intensity class A carbon cold rolled steel plates and zinc-coated steel plates.	
	The door frames of the cabinet can be installed with expansion bolts (ground) or bolts (base).	
	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.	
	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.	
Sl. No	Technical specifications/Requirements	**Compliance YES/NO**

Sl. No	Technical specifications/Requirements	**Compliance YES/NO**
	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 labor costs and facilitates quick deployment.	
	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	
	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.	
	Connecting parts such as cabinet materials, screws, and bolts should be stainless. The cabinet should be configured with matched screws and nuts.	
	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	
Sl. No	Technical specifications/Requirements	**Compliance YES/NO**

Sl. No	Technical specifications/Requirements	**Compliance YES/NO**
	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	
	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	
	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	
	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.	
	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	
	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.	
Sl. No	Technical specifications/Requirements	**Compliance YES/NO**
	Rack Based Access Control System.	**Compliance YES/NO**
	a. The Mechatronic access control system should provide an extensive range of alarms and system messages:	
	a. Unauthorized access	
	b. Status of lock(open/closed)	
	c. Green period	
	d. Blocking period	
	e. Temperature	
	B. The system should provide wide range of options:	
	a. Time stamp profiles	
	b. Days	
	c. Organizations	
	d. Temperature	
	e. Level of authentication-single, dual.	
	c. The solution should be capable for centralized architecture and decentralized architecture.	
	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.	
	e. All actions should be logged as “log events” which could be exported (pdf, html, mht, rich text, excel, icsv)	
	f. The mechatronic lock should have LED indication for status and field for display of rack name and number.	
	g. Four eye principle-Dual authorization via transponder cards.	
	h. The mechatronic lock should eliminate the use of traditional mechanical key lock for racks.	

Sl. No	Technical specifications/Requirements	**Compliance YES/NO**
	i. The mechatronic locks should able to be retrofitted on server racks of different OEM rack manufacturers.	
	j. The mechatronic lock should have proper mechanism to override in case of network failure/power failure/ emergency without breaking the device.	
	k. The admin suite should facilitate planned access and super user function.	
	l. The admin suite should have task scheduler for pre-programming the activities in DC.	
	m. The admin suite should allow specific user to be assigned to specific racks.	
	n. The admin suite integrates with authentication system like Active Directory, Radius, etc.	
	Rack Based IP PDU	**Compliance YES/NO**
	a) No. of output sockets should be minimum **IEC 320 C13 x 18 and IEC 320 C19 x 6**	
	b) Input current rating: **230V ,1-ph, 32A or 400V,3 -ph as per requirement.**	
	c) The iPDU should have alternate Phase & circuit interweaving to enable proper load balancing in case of 3 phase PDUs.	
	d) It should have billing grade +/-1% Accurate Metering of electrical parameters as per ANSI Standards	
	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.	
	f) It should conform to UL/CE, IEC Norms	
	g) All plug types, input as well as **outlet** should confirm to best **industry standards** and should have **locking capability** to avoid accidental dislodging.	
	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.	
	i) Sockets should be preferably coloured to clearly identify different circuits	
	j) It should support High Operating temperature of 0 to 60 deg C to take care of high operating temperature at back of Rack	

Sl. No	Technical specifications/Requirements	**Compliance YES/NO**
	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	
	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.	
	m) The iPDU should have dual Ethernet Ports.	
	n) Provided Solution should have capability for Simultaneous Commissioning, Updating Firmware, Setting Thresholds and Alarms across Multiple iPDUs using a centralized software	
	o) Communication module in the rack PDU should be Hot Swappable.	
	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.	
	q) For Security iPDU should support encryption via TLSv1.2	
	r) Should provide Ease of integration into third party systems supporting an API	
	s) It should be integrated with OEM's IT management software or DCIM	
	t) It should have lowest power consumption about 10W on idle.	
	u) The communications protocols supported should include:	
	v) ARP, IPv4, IPv6, ICMP, ICMPv6, NDP, TCP, UDP, DNS, HTTP, HTTPS, SMTP, SMTPS, DHCP, SNMP (v1/v2c/v3), and Syslog.	
	w) It should have adjustable threshold values with an alarm function	
	x) PDU should provide the capability of reporting error thru **email** or any other method suitable	
	y) iPDU should have capability to connect to 16 sensors (temperature, humidity, airflow, Dew Point).	
	z) It should have USB port for firmware upgrade and external log storage.	
	PDU vendor should provide centralized software for bulk configuration.	

Sl. No	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 Datacentre 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:	
	a. The RU-Level Asset Tracking system should be able to Automatically collect the information of IT assets and upload to a central software.	
	b. Should be able to Locate the asset to which rack and which U	
	c. Should be able to tell how many U heights are occupied by the asset	
	d. Should have colour indicators to Differentiate between:	
	a) Available U	
	b) Reserved U	
	c) Maintenance U	
	d) Etc. to ease On-ground operations	
	e. Should be able to automatically audit Inventory of Assets	
	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	
	g. It should provide tracking of when they are moved in/out of room.	
	Rack based Static Transfer switch,	
	16A Single phase for network racks with min 8 number of IEC C13 outlet, C20 input connector, Remote monitoring capability.	

PASSIVE NETWORK SYSTEM			
Sl. No	**Items**	**1U Rack Mount Fiber enclosure (LIU), Unloaded**	**Compliance YES/NO**
	Fiber Interface Unit	Fiber Patch Panel Typically used in Server rooms, Network rooms, Data Centres and Small Offices Can be mounted directly on any 19" rack or cabinet. It should be able to accommodate a variety of Fiber connectors and terminated to fibre cables using Splicing or other methods.	
	Type	Fiber LIU should be 1U (1.75”), 19 Inch Rack Mount 1RU 6 ports panel shall accommodate 144 fibres (72-port LC duplex	
		Dimension: H: 1.74”, W: 17” and D: 14.20”	
		Drawer sliding front-access drawers, up to 12 individual cassettes or fibre adaptive panels FAP can be quickly and cleanly removed without disrupting other cassettes.	
		12/24/48/96 Ports should be available in 1U Rack Mount Fiber Enclosure.	
		Unloaded panels should be of high density to accommodate at least 32 no’s of 10G copper ports or 144 cores of 10G fibre.	
		1U unloaded panel suitable for mounting up to 3/4 nos of pre- terminated cassettes or Frames.	
	Features & Compatibility	Each 1U LIU should be able to accommodate min of 96 fibres in LC type connectors via 96b fibre splice tray.	
		Should be equipped with front patch cord tray/manager and rear cable tray/manager	
		Front Patch Cord Manager/Tray should be with door	
		Each 1U panel should take at least 3/4 Adapter Frames or 3 Cassettes allowing flexible and customized patch panel design.	
		LIU should be able to accommodate Fiber, Copper and Multimedia Connectivity like Coaxial (BNC, F Type, RCA Connectors), HDMI, USB etc.	

Sl. No	Technical specifications/Requirements		Compliance YES/NO
		Universal Optical fibre adapter frames shall provide the connecting interface between two optical fibre connectors.	
		Adapter frames should be preloaded with adapters/couplers Duplex/Simplex.	
		Adapter frames should be of Black Color with different colored couplers	
		Panel/cassette should be available in both angled and straight versions	
		Storage Temperature -40°C To +70°C	
		Operating Temperature -10°C To +60°C	
		Max. weight should be 3.7 kg	
		Adapter frames/Cassettes should be available for both Single-mode and Multimode. Adapter should be color coded for easy identification and to avoid mixing of solution as per below.	
		Single mode Adapters – Blue Color	
		Multimode OM3 Adapters – Aqua Color	
		Multimode OM4 Adapters – Erika Violet Color	
		Single mode APC Adapters – Green Color	
		It should include Screws (12-24); Screws (10-32); Screws (8-32); Tie Wraps; Kurly locks; Velcro Straps; Identification Labels	
		Adapter strips should be available in LC/SC/ST types.	
	Standard	Fiber LIU should comply to EIA/ECA 310	
		RoHS Compliant	
	Warranty	25 Years	

MPO-LC Cassette, OM4, MPO-12 (Female), LC DUPLEX/QUADPLEX			**Compliance YES/NO**
	Suitable Applications	Fiber Ultra High-Density Solutions, Backbone, Telecommunications Room, Main Distribution Room, Datacentre's. Rack Mount and Wall Mount Panels.	
	Type	**6 LC Duplex Ports (12 Fibers) / 12 LC Duplex Ports (24 Fibers) / 9 LC Quad Ports (36 Fibers)**	
		Adapter should be **Multimode OM4 with Erika Violet Color**	
		LC Type Connectors will be required with DUST CAPS.	
	Features &	Pre-terminated cassettes with 1/2/3 MPO trunk connections at rear	
	Compatibility	6/12/18 x LC Quad/Duplex (fibres) connection in the front	
		Universal Optical fibre adapters shall provide the connecting interface between MPO -12 and LC Connectors.	
		Cassette should be available with 18 LC Duplex (36 Fiber) connector option for High Density Solution	
		Couplers in adapter strip should be Erika Violet Colored	
		Adapter Sleeve: Zirconia-Ceramic	
		Front Connector Body: LC Duplex - Plastic - UL94 (Erika Violet Color)	
		Rear Connector Body: MPO Female – Plastic – UL94V-0 (Black Color)	
		Cassette Assy: Plastic - UL94V-0 (Black Color)	
		Color of LC Couplers/Connector in Cassette should have same color which is for MPO-12 OM4 Trunk Cables and LC Duplex OM4 Fiber Patch Cord	
	Optical Parameters	Insertion Loss (per channel): 0.35dB (max).	
		Return Loss 26dB (OM3/OM4) per channel.	

Sl. No	Technical specifications/Requirements		Compliance YES/NO
		Attenuation <= 0.20 dB, for MPO Connector at rear	
	Standard	TIA 568. C.3	
		RoHS Complied	
		25 Years Performance Warranty	
MPO-12 Trunk Cable, Multimode OM4 Gender and Polarity changeable LSZH Jacket			**Compliance YES/NO**
	Type	MPO-MPO Trunk Cable, 12F, Male/Male or Female/Female, Straight/Cross (Polarity and Gender hangable)	
		Multimode 50/125 OM4	
	Feature	Multimode 50/125 um OM4 should be of Erika Violet Color for easy identification from OM3	
		Loose tube cable construction with Round jacket and LSZH outer sheath	
		Must have LSZH Jacket.	
		IEC 60332-3 Flame Retardant Standard LSZH Jacketed	
		1 to 500 Meter Put-up Length with Pulling Eye Options at both ends	
	Outside Nom. Diameter	4.5 mm	
	Jacket Material	LSZH	
	Color	Color of fibre trunk cable should be same as color of fibre patch cords and Adapters/Couplers in Cassettes	
	Jacket	LSZH Jacket Construction	
	MPO Connector	Color – same as MPO trunk cable jacket color, Thermoplastic Ferrule	
	Minimum Cable	150 N Tensile Strength	
	Retention Strength	440 N/100mm Crush Resistance	

Sl. No	Technical specifications/Requirements		Compliance YES/NO
	Insertion Loss	≤ 0.35 dB @ 850nm	
	Return Loss	≥ 20 dB @ 850nm	
	RoHS/ELV Complied	Yes (Should be mentioned in datasheet)	
	Standard	TIA 568-C.3	
Fiber Patch Cords, LC-LC Duplex, Multimode OM4 BI, 3MT for Server Racks			**Compliance YES/NO**
		-	
	Type	1.6mm Duplex Zip cord.	
		Multimode OM4 Bend Insensitive, Erika Violet Color	
	Feature	Multimode OM4 should be of Erika Violet Color for easy identification from OM3.	
	Outside Diameter	(Duplex): 1.6mm as per design	
	Jacket Material	LSZH	
	Length	3 MT	
	Identification	Color of fibre patch cord should be same as color of Trunk Cables and Adapters/Couplers in Cassettes	
	Minimum Cable	2.0/3.0mm: 200 N Tensile Strength	
	Retention Strength	2.0/3.0mm: 1000 N Crush Resistance	
	Insertion Loss	≤ 0.3 dB	
	Return Loss	≥ 25dB @ 850nm	
	RoHS Certified	Yes	
Fiber Patch Cords, LC-LC Duplex, Multimode OM4 BI, 3MT for Equipment Racks			**Compliance YES/NO**
		-	
	Type	2mm Duplex Zip cord.	
		Multimode OM4 Bend Insensitive, Erika Violet Color	

Sl. No	Technical specifications/Requirements		Compliance YES/NO
	Feature	Patch Cord should be with some pull feature for easy removal without touching any other couplers/patch cords in 144 Fiber High Density Fiber Patch Panel in Equipment Racks.	
		Multimode OM4 should be of Erika Violet Color for easy identification from OM3.	
	Outside Diameter	(Duplex): 1.6 mm or as per design	
	Jacket Material	LSZH	
	Length	3 MT	
	Identification	Color of fibre patch cord should be same as color of Trunk Cables and Adapters/Couplers in Cassettes	
	Minimum Cable	2.0/3.0mm: 200 N Tensile Strength	
	Retention Strength	2.0/3.0mm: 1000 N Crush Resistance	
	Insertion Loss	≤ 0.3 dB	
	Return Loss	≥ 25dB @ 850nm	
	RoHS Certified	Yes	
	Details	**Adapter Frame for Hybrid Patch Panels, Copper 6 PORTS**	
	Suitable Applications	Fiber Ultra High-Density Solutions, Backbone, Telecommunications Room, Main Distribution Room, Datacentre's. Rack Mount and Wall Mount Panels.	
	Feature and Compatibility	**6 Ports (Can Accept 6 No. of Cat6A Modular jack)**	
		Adapter should be **Black Color with BLUE Color Modular jack**	
		Labelling should be provided on top of the adapter frames	
		Universal adapter strips shall provide the connecting interface between two optical fibre connectors.	
		Adapter strips should be available in 6 and 8 Ports both	

CAT6A U/UTP LSZH CABLE			**Compliance YES/NO**
	Type	23 AWG solid bard copper, Unshielded Twisted 4 Pair, Category 6A, confirming to TIA 568.2.D Class EA - ISO/IEC 11801 All four pairs shall be surrounded by advanced Matrix tape and	
		a flame retardant jacket.	
	Conductors	Solid bare copper 23 AWG	
	Insulation	Polyolefin	
		1.14 mm OD	
	Jacket	LSZH jacket complying to:	
		PVC (CM): IEC 60332-1 and UL 1685	
		HDPE (LSZH): IEC 60332-1, IEC 60332-3-22, 60754-2, 61034-2;	
		EN 50575: Euro Class Dca-s2, d2, a1	
		HDPE (LSZH-3): IEC 60332-3-25 (-3d), NBN C 30-004(F2), 60754-2, 61034-2;	
		EN50399: Euro Class Dca-s2, d2, a1; EN 50575: Euro Class Eca	
		HDPE (Cca): IEC 60332-3-25 (-3d), NBN C 30-004(F2), 60754-2, 61034-2;	
		EN50399: Euro Class Cca-s1a, d1, a1	
		HDPE (B2ca): IEC 60332-3-25 (-3d), NBN C 30-004(F2), 60754-2, 61034-2;	
		EN50399: Euro Class B2ca-s1a, d1, a1 All above parameters should be available in technical sheet	
	Round cable design	Improves fill capacity, cable management, reduces required bend radius and allows efficient use of pathways and spaces	
	Suitable Applications:	Premise Horizontal Cable, 10 Gigabit Ethernet, 100BaseTX, 100BaseVG ANYLAN, 155ATM, 622ATM, NTSC/PAL Component or Composite Video, AES/EBU Digital Audio, AES51, RS-422, Noisy Environments, PoE	

Sl. No	Technical specifications/Requirements		Compliance YES/NO
	Guaranteed Bandwidth	**650 MHz for 100 MT Channel**	
	Packing	Box of 305 meters	
	Cable Outer Diameter	**7.1 mm**	
	Delay Skew	**45 ns @ 100M**	
	Bend Radius (Installation)	50 mm	
	Maximum Conductor DC Resistance:	DCR @ 20°C (Ohm/100 m) < 9.5	
	Third Party Verification	ETL Test Report for compliance to 61156-5 as referenced in ISO/IEC 11801-1 for Min. 500Mhz or Higher	
		ETL Test Report for Alien crosstalk (6 around 1) for ANEXT, AFEXT, PS ANEXT.	
		ETL Test Report for testing at elevated temperature of 40 Deg C and 60 Deg C respectively min. 500 MHz or higher for IL, Propagation Delay and Delay Skew	
		All above test reports to be submitted along with bid	
	Nom. Mutual Capacitance	Capacitance (nF/km) < 56	
	Nom. Velocity of Propagation	0.67	
	Extended Temperature Range Operation	Allows operation in 75°C (167°F) ambient environment providing error-free performance in high-density cabinets and large cable bundles running PoE+ or PoE++ applications	
	Performance characteristics @ 650 MHz	Max. Attenuation: 45.4 dB/100m	
		Min. NEXT: 34.8 dB Min. PS NEXT: 31.8 dB	
		Min. Return Loss: 17.3 dB	

		Min. PSACRF: -11.0 dB	
		Min. PS ANEXT: 52.0 dB	
		Min. PS AACRF: 24.2 dB	
	PoE Compatibility	Meets IEEE 802.3af, IEEE 802.3at and IEEE 802.3bt for PoE applications	
	ETL Test Report Submission	**Average DCR <= 8.0 Ohms @ 20 Deg C,**	
		Avg. Delay Skew <= 41ns,	
		Resistance Unbalance <=1%,	
		Max. Capacitance Unbalance <= 100pf/100m	
	RoHS	Yes	
Cat6A UTP Modular Jacks			**Compliance YES/NO**
	Feature	The jacks shall not have an integrated spring shutter as the shutter malfunctions and causes operational issues in Panel	
	Operating Temperature	-10° to 65°C	
	Dielectric Strength	1,000 V RMS @ 60 Hz for 1 minute (Signals to Ground)	
	Performance Characteristics to be provided with bid for 1 – 500 MHz or Higher	Technical Datasheet should have Worst Case Performance parameters for Attenuation, NEXT, FEXT, Return Loss, PSANEXT and PSAACRF	
	Electrical Performance @ 500 MHz or Higher	Insertion Loss: Max. 0.48 dB	
		NEXT: Min. 37.0 dB	
		FEXT: Min. 31.0 dB	
		RL: Min. 12.8 dB	
		PSANEXT: Min 56.0 dB	

Sl. No	Technical specifications/Requirements		Compliance YES/NO
		PSACRF: Min 56.0 dB	
		Balanced TCL: Min 19.0 dB	
	Termination Process	Termination of cable on IO through toolless.	
	Warranty	It should be covered under 25 year warranted solution from OEM.	
Cat6A UTP Patch Cords, LSZH Jacket			**Compliance YES/NO**
	Type	Modular Cord shall meet and exceed channel specification of ANSI/TIA/EIA-568.2-D Category 6a and ISO/IEC 11801 2nd up to 500 MHz when used as a component in a properly installed UTP channel. It should also comply to EN 50173-1 (20	
	Conductor	Stranded copper ETP, 7/26AWG(0.16mm)	
	Insulation	Foam-skin Polyethylene (1.05 mm +/- 0.05 mm)	
	Length	2 / 3 / 5 Meter	
	Plug Boot	Clear boot with PVC material	
	Plug Housing	Polycarbonate (PC)	
	Plug contact blade	Phosphor bronze plated with 1.27um gold over 2.54um nickel undercoat	
	Mating Cycle	2500 mating Cycles	
	Operating/Storage Temperature Range	-20 to +60 Deg C	
	Channel compliance certificate	Certificate by Intertek (ETL) for the 4-Connectors and 3 Connectors channel testing to the Cat 6A Cabling system as per the ANSI/TIA 568 C.2 standards, ISO/IEC 11801 and EN 50173-1. Document to be submitted.	
	Guaranteed Bandwidth	Min. 500 MHz or Higher Guaranteed Bandwidth	
	Construction	Pairs in Metal Foil, Overall cable with braid shield	

Sl. No	Technical specifications/Requirements		Compliance YES/NO
	Sheath Material	LSZH	
	OD	7 .0 mm ± 0.3	
	Performance	Patch Cords which will give guaranteed higher bandwidth will be preferred (not just tested).	
48 PORT ANGLED UNLOADED JACK PANEL, 1U			**Compliance YES/NO**
	Type	-48 Port 1U Unloaded Angled Patch Panel	
		-Patch panels IDC Connectivity should be at rear end & RJ-45 jack on front panel, 19" rack mountable.	
		-Patch Panels Ports should be individually replaceable & Consistent port-to-port performance.	
	Cable management	Patch Panel to be supplied with a cable support bar/kit	
	Compatibility	Patch Panel should be able to accept Cat6A, Cat6 and Cat5e information outlets for backward and forward compatibility and POE compatible.	
	Height & Color	1U (1.75”), Black Color	
	Feature	The jacks shall not have an integrated spring shutter as the shutter malfunctions and causes operational issues in panels	
	Storage Temperature Range	-40Deg C to +70 Deg C	
	Operating Temperature range	-10Deg C to +60 Deg C	
	Color and Material	Made up of Steel and should come with 4 Screws (10x32); 4 Screws (12x24); 2 Velcro Straps; 2 Rear Cable Management Bracket, 1 Cable Management Bar in the Packing	
	Applicable Standards & Environmental Programs	RoHS complied	

Sr. No	Item	Detailed Specification Description	Compliance YES/NO
Videowall			
	The control room solution should consist Laser DLP based Video wall cubes. It should be possible to show any of the input sources or all the input sources in any position on the wall, in any size and any configuration		
	Cube & Controller	Display & controller should be from the same manufacturer	
	Reputed Company	The OEM should be an established multinational in the field of video walls and should have at least 500 DLP cube installations.	
	OEM Capability	Only those OEM's would be considered who also manufacture the Projection/Optical engine as well apart from the whole cube. Companies claiming to be OEM's but not manufacturing their own Projection/Optical engines shall not be considered to ensure long term support.	
	Native Resolution of Video wall	The video wall should have minimum resolution go 11000 x 4200 pixells.	
	Light Source Type	Laser light source.	
		Individual cube should be equipped with multiple laser banks and each laser bank should have an array of diodes. Single or multiple diode failure should not impact image display on the screen	
	Brightness of Projection engine	Minimum 2200 lumens	
	Brightness of Cube	Minimum 400 nits and should be adjustable for lower or even higher brightness requirements	
	Brightness Uniformity	≥ 98 %	
	Dynamic Contrast	1000000:1 or more	
	Critical component of Videowall cube (i.e. Projection engine)	Projection engine must comply to Industry standard IEC / EN 60529 to avoid the entry of dust to ensure longer life of system. System should be tested and certified by a 3rd party lab.	

Sl. No	Technical specifications/Requirements		Compliance YES/NO
	Control	IP based control to be provided	
	Remote	IR remote control should also be provided for quick access	
	Screen to Screen Gap	≤ 0.2 mm	
	Screen Support	Screen should be minimum 3 layers with a Hard Backing to prevent bulging	
	Control BD Input terminals on the cube No format convertors to be employed.	Input: 1 x Digital DVI, Input: 1 x HDMI, Input: 1 x Display Port, Input: 1 x analog Dsub-15,	
	Power Supply	Dual Redundant and Hot Swappable Power Supply. This should be built inside the cube for fail safe operation. Power supplies extended or kept outside the cube are not acceptable	
	Cooling Inside Cube	By Means of a sealed heat pipe or any other method which does not contain hazardous liquid, details to be provided.	
	Cube Size	Each cube should have a screen size of 1550 mm wide and 872 mm high and 560 mm depth. The cube size can have a tolerance of ± 2% in size	
	Monitoring of critical parameters to ensure stable operation of the system 24 x 7	Internal Temperature	
		Ambient Temperature	
		Humidity	
		Brightness	
		Cooling	
		Light Source Status	
		Should be possible to demonstrate these parameter through an active monitoring interface	
	Protocol	System should support industry standard network protocols: DHCP, UDP, TCP /IP	

Sl. No	Technical specifications/Requirements		Compliance YES/NO
	Dust Protection	Engine should be protected from dust and should be IP6X certified by a third-party laboratory	
	Cube control & Monitoring	Videowall should be equipped with a cube control & monitoring system	
		System should be based on Python- Django framework with web browser architecture	
		Should be able to control & monitor individual cube, multiple cubes and multiple video walls	
		Provide videowall status including Source, light source, temperature, fan and power information	
		Should provide a virtual remote on the screen to control the videowall	
		Input sources can be scheduled in " daily", "periodically" or "sequentially" mode per user convenience	
		System should have a quick monitor area to access critical functions of the videowall	
		User should be able to add or delete critical functions from quick monitor area	
		Automatically launch alerts, warnings, error popup windows in case there is an error in the system	
		User should be able to define the error messages as informational, serious or warning messages	
		Automatically notify the error to the administrator or user through a pop up window and email	
		Status log file should be downloadable in CSV format as per user convenience	

Sl. No	Technical specifications/Requirements		Compliance YES/NO
CONTROLLER			
	The Controller should be able to make all the cubes behave as one logical area. It should be possible to display any or all the inputs on the video wall in any desired configuration.		
	Architecture	Should be based on Server architecture	
	Operating System	Windows 7 or higher -64 bits	
	RAM	16GB or higher	
	HDD	500 GB or higher	
	RAID	RAID should be provided	
	CPU	Intel i5 or better	
	Power Supply	Dual Redundant Power Supply	
	Inputs	10 DVI Inputs, Dual LAN	
	Chassis	19" rack mount industrial chassis	
	Unix/Linux Emulation	Should be possible to display images from Unix/Linux workstation	
	Wall Management Software	Software to be provided to manage the layout on the display	
	Wall management SW		
	Client & Server based Architecture	Should supports Multi client/Console control the Wall layouts	
	Scaling and display	Software enable user to display, multiple sources up to any size and anywhere on the display wall.	
	RS232, TCP/IP	RS232 & TCP/IP support should be available for other interfaces	
	Remote Control	Wall can be control from Remote PC through LAN	
	Layout Management	Should support for Video, RGB, DVI, Internet Explorer, Desktop Application and Remote Desktop Monitoring Layouts	
	Scenarios	Software should able to Save and Load desktop layouts from Local or remote machines	

Sl. No	Technical specifications/Requirements		**Compliance YES/NO**
	Layout Scheduler	All the Layouts can be scheduled as per user convenience	
		Software should support auto launch of Layouts according to specified time event by user	
	Launch Application	Software should able to Support	
	Integration with touch Interface	system can able to work with 3rd party touch interfaces (Creston, Extron, AMX etc.)	
	User friendly	Software should be user friendly	
	Protocol	VNC	
	Interface	LAN	
	Scaling and display	Display of multiple sources up to any size, everywhere on the wall	
	Multi View	Supports multiple view of portions or regions of Desktop, Multiple Application Can view from single desktop simultaneously	
	Control operator workstations	Software should able to Support	
	Multiple concurrent client users	Software should able to Support	
Sr. No.	**Parameter**	**Technical Specification**	Compliance YES/NO
Workstation			
	Type	Workstation	
	Processor	Intel Latest generation core i7	
	Operating System	Latest Windows professional version	
	Memory	8 GB	
	Hard drives	1TB SATA HDD.	
	Graphics	HD graphics card	
	Connectivity	RS 485, USB, HDMI out, LAN	
	Monitor	17” LED monitor	

Annexure - 3: Hardware specification of RTU

Table-1: Technical Specification of RTU

Sl. no.	Item Description	Value	Remarks
Make			
Model			
1	Data transmission rate	300 to 9600 bps for serial port & 10/100 Mbps for Ethernet port.	Configurable
2	Communication ports	Minimum following Ports: ▪ 2 Ethernet port for comm. with master stations on IEC-104 ▪ 2 Ethernet ports for comm. with IEDs, Energy Meters. ▪ 2 RS232 ports for comm. with master stations on IEC-101. ▪ 1 Port for Cellular Data Communication. ▪ 1 Port for RTU configuration & Maintenance tool ▪ 1 port for LDMS ▪ 1 Optical comm. Port ▪ 2 RS 485 ports for polling MFMs/MFTs/ Energy Meters	
3	Communication protocol with Master stations	IEC 60870-5-101/ 104	
4	Communication Protocol with LDMS	IEC 60870-5-104	
5	Communication Protocol with MFTs/MFMs/Energy Meters	MODBUS/IEC 60870-5-101/104	
6	Communication Protocol with IEDs	IEC 61850	
7	Status data transfer to Master station	by exception	
8	Analog data transfer to Master station	Normally Periodic For major change – by exception	

Sl. no.	Item Description	Value	Remarks
Make			
Model			
9	No. of Scan Groups supported	16	
10	No. of Separate Logical Database for each Master Station	4	
11	RTU shall be able to capture contact operations	of 20 ms or more duration.	
12	SOE buffer size	at least 5000 events	
13	Time stamping accuracy for SOE	1 ms	
14	Supporting Control of Devices	Two state & OLTC capacitors	
15	Downloading of RTU database from master station	Supported	
16	Nominal Power supply voltage	48V DC	
17	Compliance to cl. 1.28.1 – Transducer Protection	Yes	
18.	Compliance to basic requirements of IEEE - 1686 Standard for Intelligent Electronic Devices Cyber Security Capabilities.	Yes	

10.3 Annexure – 4: MINIMUM BILL OF MATERIAL

10.3.1 Part A – SCADA System

Part -A : SCADA DMS System			
SN.	**Description**	**UOM**	**Qty**
Part -A	**SCADA DMS System**		
A.	**Software**		
1	SCADA and Historian software	Lot	1
2	DMS Software	Lot	1
3	ISR software	Lot	1
4	ICCP Communication	Lot	1
5	Front End Processor software	Lot	1
6	Data Replica Server Software	Lot	1
7	Database development system (PDS) cum test bench for SCADA and ICCP Integration	Lot	1
8	Dispatcher Training Simulator software	Lot	1
9	**Web / Network security software**		
(a)	Host based IPS with Antivirus software for all machines	Lot	1
(d)	Software for Web Server	Lot	1
10	Web Access Thin Client Software	Lot	1
11	Outage Management	Lot	1
12	Backup Software	Lot	1
B.	**Hardware**		
1	SCADA/DMS server	Nos	2
2	ICCP Communication Server	Nos	2
3	ISR (Historical) Server	Nos	2
4	Interface Server (for integration with external applications/ domain)	Nos	1
5	**Extendable storage bay comprising of following :**		
(a)	LTO drive for back up	Nos	1
(b)	SAN	Nos	2
(c)	Antivirus Server	Nos	1
(d)	Backup Server	Nos	2
(e)	SAN Switch	Nos	2
6	Communication Front End server for communication with field RTU, IEDs etc.	Nos	2
7	DTS server	Nos	1
8	PDS server cum test bench for SCADA and ICCP Integration and development system as test bench for cyber security	Lot	1

Part -A : SCADA DMS System			
SN.	**Description**	**UOM**	**Qty**
Part -A	**SCADA DMS System**		
9	Workstation Console with 26 inch Dual TFT Monitors	Nos	4
10	Workstation (Training Console for DTS)	Nos	1
11	Industrial grade 16 port serial server, 230V AC power input (19" Rack Mount type) for Control Centre	Nos	3
C.	**LAN Switches**		
1	L3 Core Switch (24 port with 10 Gbps) for SCADA/DMS LAN	Nos	2
2	L3 DMZ Switch (12 port with 10 Gbps)	Nos	2
3	GPS Receiver Switch (12 port with 10 Gbps)	Nos	2
4	L2 Access Switch for NoC, SoC and DCC	Nos	1
5	Fibre and Ethernet Structured Passive Cabling	Lot	1
D.	**Web system**		
1	Web server for web access of SCADA	Nos	2
2	External Firewall	Nos	2
3	Internal Firewall	Nos	2
4	External Intrusion Prevention System		
5	Internal Intrusion Prevention System		
6	Centralized Management workstation for console	Nos	2
E.	**Time & Frequency system**		
1	GPS Time synchronization system	Nos	2
2	Day & Date Digital Displays	Nos	2
3	Digital Display for Time	Nos	2
F.	**Remote Monitors (Remote VDU with single TFT monitor)**	Nos	4
G.	**Laptop (Craft Terminal) for maintenance Printer**	Nos	2
H.	Reputed make only- HP / Canon / Samsung etc) (* Locally if possible due to cartridge unavailability problem)		
1	Colour Laser Printer	Nos	2
2	B/W Laser printer	Nos	2
I.	**Rack Mountable TFT with IP based KVM switch**	Nos	2

10.3.2 Part B – SCADA System FRTU

Part -B : SCADA DMS System FRTU			
SN.	**Description**	**UOM**	**Qty**
Part -B	**SCADA DMS System FRTU**		
1	RTU base equipment comprising panels, racks, sub-racks, Power Supply modules, Communication Modules, interfacing equipment, required converters & all other required items/accessories including complete wiring for all modules.	Nos	35
2	LDMS system along with software including Anti virus for three years.	Set	35
(a)	Furniture for LDMS system (One table and One chair suitable for Computer operation of Godrej make)	Set	35
(b)	Inverter	Nos	35
3	OLTC transducer	Nos	80
4	Heavy Duty Relay	Nos	700
5	Contact Multiplying Relay (CMRs)	Nos	8730
6	Multi-Function Meters (MFMs)	Nos	340
7	Time Synchronisation equipment without display	Nos	35
8	CPU(Digital out Put Module)	Nos	70
9	Analog Input Module (4 channels/card)	Nos	35
10	Digital Input Module (32 channels/card)	Nos	263
11	Digital Output Module (16 channels/card)	Nos	65
12	**Test Equipment for RTU**		
(a)	Master Station cum RTU simulator & Protocol Analyser Software tool	Nos	1
(b)	Laptop PC for above software tools alongwith interfacing hardware (Intel Core i5, 8GB RAM,1TB HDD, 15.6" display, Windows-10 with licensed MS office and Antivirus (Latest Version)	Nos	1
13	**1.1KV Control Cables (Copper) for each C&R panels connection with RTU**	LS	1
(a)	Cat 6 for MFT		
(b)	14Cx1.5 sq.mm (Digital Input)		
(c)	4Cx2.5 sq.mm (Digital Output Trip/Close)		
(d)	PVC Conduit (Suitable size as per site requirement)		
(e)	Any other item required to complete the project (Details of items should be furnished)	LS	1
14	GPRS based Modem for data connectivity from RTU to DCC	Nos	35
15	Erection and Commissioning including small items viz TBs. Lux . Ferrules. Channels, etc/	Set	35

10.3.3 Part C –Building civil work and Conveyance System/IT infrastructure/DC facility

Part - C : Building Construction Area			
SN.	**Description**	**UOM**	**Qty**
Part -C	**Building Construction Area**		
1	Server Farm Area	Per Sqft.	1760
2	NOC Area	Per Sqft.	700
3	SOC Area	Per Sqft.	570
4	BMS Room Area	Per Sqft.	150
5	Power Room Area	Per Sqft.	310
6	Staging Area	Per Sqft.	240
7	Manager Cabin's Area	Per Sqft.	350
8	Reception Area	Per Sqft.	200
9	DCC Area	Per Sqft.	970
10	Rest rooms Area	Per Sqft.	170
11	4K Laser Video wall System 3X2 configuration, (each module size-70" diagonal) and each video wall with (two rows X three columns configuration)	Nos.	4

Detailed BOQ of Part C – DC and other area for reference only. The price quoted shall include for whole infrastructure covering DC, DCC, SOC, 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 is also required to provide the costs for various components included in the DCC building container and infrastructure for Data Center /DCC area as mentioned below. Please enclose separate detail sheet including cost of individual items.

Detailed BOQ of Part C – Building Construction Area (As applicable)

Civil and Interior Package

CIVIL AND INTERIOR PACKAGE			
SN.	**Description**	**UOM**	**Qty**
1.0	**Container**: ISO 40ft (or as required) container, 12192mm * 2438mm / 3495mm*3600mm（D*W*H)	NOS	24+
2.0	**PCC Flooring:** Supply and layout of Plain cement concrete (PCC) on the surface of the entire area after removing debris from the floor with equal level at all sides. Aggregate must comply IS 383. Cement sand and coarse aggregate shall be at a ratio of 1:2:4	SQR MTR	600
3.0	**Antistatic FLOORING:** Supply & Fixing of 2 mm thick antistatic flooring with required accessories for UPS and battery rooms; DC room, BMS room, staging area and Ramp	SQR MTR	160

CIVIL AND INTERIOR PACKAGE			
SN.	**Description**	**UOM**	**Qty**
4.0	**Carpet Flooring:** Providing and laying of 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.	SQR MTR	450
5.0	**INSULATION**: Supply, Installation, Testing & Commissioning of Thermal Insulation: Supply & fixing of thermal insulation above ceiling with 19mm thick XLPE/Nitrile rubber on the DC surface and under the roof of the entire area	SQR MTR	500
6.0	**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.	SQR MTR	330
7.0	**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	SQR MTR	80
8.0	**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.	SQR MTR	400

CIVIL AND INTERIOR PACKAGE			
SN.	**Description**	**UOM**	**Qty**
9.0	**FIRE RATED DOORS** :Providing and fixing single or double steel door shutters with 45mm thk 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		
10.0	(1200mm + 300 mm) x 2400 mm unequal double Leaf door	NOS	4
11.0	1200mm x 2400 mm single Leaf door	NOS	2
12.0	900 mm x 2400 mm single Leaf door with panic bar	NOS	3
13.0	**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.		
14.0	900 mm x 2100 mm single Leaf door	NOS	7
15.0	**PAINTING**: Supply, Installation, Testing & Commissioning of premium Plastic emulsion paint on ceiling/ walls three or more coats with roller I/c applying cement primer, making smooth surface with putty to the satisfaction of architect.	SQR MTR	1150
16.0	**Fire paint -** 2 hr 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 / palti and rubbing down the surface, lambi/palti sandwiched with two coats of approved primer, rate to include all tools, labour, scaffolding, primer as required completed as directed by the engineer.	SQR MTR	160
17.0	BLINDS: Venetial vertical collapsible blinds of appropriate colour for Glazed walls.	SQR MTR	75
18.0	**FURNITURE**		
19.0	Technical Workstations for Control Room Area	NOS	39
20.0	Providing and fixing of 750mm high Powder coated steel cabinets with shelves, locks, handles etc.	SQR MTR	10

CIVIL AND INTERIOR PACKAGE			
SN.	**Description**	**UOM**	**Qty**
21.0	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	50
22.0	Supply of three-seater sofa with fabric outer layout as per technical specification	NOS	3
23.0	Workstation running counter with 19 mm prelaminated board with smooth Surface and colour as approved by NEA and with drawer pedestal unit, wire manager.	Mtr	39
24.0	Supply of glass top Centre table mounted on teak wood polished frame	NOS	3
25.0	High back chair with armrest and comfort cushion	NOS	4
26.0	Reception table as per specification	NOS	1
27.0	File cabinet for cabins	NOS	4
28.0	Manager table as per specification	NOS	4
29.0	Dust bins	NOS	10
30.0	Wall clock	NOS	5
31.0	Printer table	NOS	2
32.0	Shoe rack	NOS	2
33.0	Hawaii slippers	PAIR	15
34.0	Staging room Table	NOS	1
35.0	BMS room counter table	MTR	7
36.0	Signages	NOS	10
37.0	Housekeeping, malba removal, and other miscellaneous works	LOT	1
38.0	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 the department.		

HVAC Package

HVAC PACKAGE			
SN.	**Description**	**UOM**	**Qty**
1	In-room 55kw DX air conditioner， including indoor unit, outdoor unit, supporting frame, copper pipe, and other accessory	Nos	12
2	VRV/VRF air conditioning system, multi-connected, outdoor unit, cooling capacity 101kW, Power: 29.3 kW, power input 380V/50 Hz, DC variable frequency, Supply, installation, and commissioning of multi-connected indoor units.	Nos	1
3	VRV/VRF multi-connected indoor unit, cooling capacity 6.3 kW, Air volume: 1000 m3/h,	Nos	9
4	VRV/VRF multi-connected indoor unit, cooling capacity 5.6 kW, Air volume: 1000 m3/h	Nos	5
5	VRV/VRF multi-connected indoor unit, cooling capacity 4.5 kW, Air volume: 680 m3/h	Nos	1
6	Ventilation system	Lot	1

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 with stand 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	36
2	SITC of 42U Network Racks (800 mm x 1200 mm) UL approved/complied; The Rack should be able to with stand 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	4
	rPDU		
1	Rack Power Distribution Unit, monitor Type-1PH-Full height vertical -Free mounting plate	Nos	100
	Aisle Containment		
1	Rack aisle containment, including two glass door 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 where ever 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 5 years comprehensive warranty and support		
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	Rm	80
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).	No	10
4	250 A End cap at the end of the every BBT	No	10
5	250A joint packs	No	24
6	Hangers	No	40
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.	No	80
9	ANY OTHER ITEM THE BIDDER MAY SUGGEST TO MAKE THE PACKAGE COMPLETE (PLS ADD BELOW)		

UPS, Battery and Power distribution board Package

UPS, BATTERY and Power distribution board PACKAGE			
SN.	**Description**	**UOM**	**Qty**
1	**Power**: Supply, fixing and commissioning of 300 KVA/300 KW Modular UPS S 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 30 minutes 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

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.	Ls	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. Operation of sampling unit and status shall be able to display in fire alarm central unit.	Nos.	1
	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	Nos.	4
2	HFC-227ea 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	Nos.	23
	CCTV SYSTEM		
1	IP Indoor Dome Camera 2MP Onvif Compliant	Nos.	36
	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.	No.	36
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
	DATA CENTER INFRASTRUCTURE MONITORING SYSTEM (DCIM)		
1	DCIM system should be modular and support perpetual licensing which provides us flexibility to purchase and expand enhanced modules according to NEA future need. All requisite hardware's like servers should be supplied along with DCIM software.	Ls	1

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 Fibre Patch Cord FOR CASSETTE TO SWITCH CONNECTIVITY as per specifications At RACK	Nos	200
6	Supply of Pre-Terminated OM3 LC-LC 1 Meter LSZH Fibre 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 Fibre 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 Fibre 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	Cat.6A, Patch Card U/UTP, C/C, 2m	Nos	100
18	UTP Patch Cord, 3.0m	Nos	100
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

PASSIVE N/W CABLING			
SN.	**Description**	**UOM**	**Qty**
24	ANY OTHER ITEM THE BIDDER MAY SUGGEST TO MAKE THE PACKAGE COMPLETE (PLS ADD BELOW)	Nos	50

Diesel Generator Package

DIESEL GENERATOR PACKAGE			
SN.	**Description**	**UOM**	**Qty**
1	Supply of Data Center Continuous Rating 625 kW SILENT DG comprising of developing min700 BHP Coupled to alternator mounted on a common base frame, complete with	Set	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	Set	2
	EXHAUST SYSTEM		
a	Supply of cladding for the residential silencers	No.	2
3	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.	Set	2
4	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	No.	2
d	BMS integration of DG set	No.	1

Video Wall Package

VIDEO WALL PACKAGE			
SN.	**Description**	**UOM**	**Qty**
1	Laser VIDEO WALL CUBES IN 3(C) X 2(R) CONFIGURATION COMPLETE WITH BASE STAND COMPLYING TO THE TECHNICAL SPECIFICATIONS	LOT	4
2	Wall management Software	LOT	4

Electrical Works for DCC building

C	Electrical Works: excluding the works specified in Part C		
C1.	ILLUMINATION SYSTEM for DCC building	LS	1
C1.	LUMINAIRES (FIXTURES)		
	Accessories: screws, gripes, pvc tape, choke, starter, Tube, bulbs, holder, flexible wire etc all complete.		
1	Ceiling Down light Hight efficiency circular LED Down Light heavy carrier with LED etc all complete.Hight efficiency circular LED Down Lighter		
2	FTL mirror optic. surface/recessed mounting with electronic choke		
C2	FAN / EXHAUST FAN/AC	LS	1
	Accessories: nut, bolt, hookclamp, dimmer switch, flexible wire etc all complete.		
1	Wall Mounted split type Air Conditioning system		
2	Exhaust fan or eqvt.etc all complete.		
C3	SOCKET,SWITCH ,JUNCTION BOX (Flush type)	LS	1
	Accessories: metal box, screws, gripes, flexible wire etc all complete.		
	Dimmer for ceiling fan all complete.		
C4	POINT WIRING / WIRES	LS	1
	Accessories; HDPE polythene pipe,screws,pvc tape, grips, circular box etc all complete.		
C5	EARTHING	LS	1
	ANY OTHER ITEM THE BIDDER MAY SUGGEST TO MAKE THE PACKAGE COMPLETE (PLS ADD BELOW)		

Water sprinkler system Fire Extinguishing System for DCC building & Adjacent Area

3	Supply of ABC powder type portable fire extinguishers all complete.	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 DCC building

4	2 Ton capacity lift for equipment and personnel		
	2 Ton capacity lift 3 floors all complete	set	1
	ANY OTHER ITEM THE BIDDER MAY SUGGEST TO MAKE THE PACKAGE COMPLETE (PLS ADD BELOW)		

11. Appendices

11.1.1 Appendix – A

List of IO Points

1. MW and MVAR for all lines , transformers, reactors and Capacitors
2. Voltage of all buses
3. Frequency of 220kV Bus
4. All Breakers ON and OFF Status,
5. All Breakers ON and OFF Control,
6. All isolators ON and OFF Status
7. Tap Position Indication and Pulse Output (Optional) for all transformers
8. Master protection signal for all feeders, transformers Units and Bus Bar
9. Loss of Voltage signal for Bus bar.
10. Temperature value per substation.
11. Any other point decided during detailed engineering

11.1.2 Appendix – B

LIST OF ABBREVIATIONS

- AMCC Advanced metering control computer MDM
- AMC Annual Maintenance Contract
- AMI Advanced Meter Infrastructure
- AMR Automatic Meter Reading
- BI Business Intelligence
- BMS Billing Management System
- BOQ Bill of quantity
- COSEM Companion Specification for Energy Metering
- CPP Critical Peak Pricing
- CPU Central Processing Unit
- DA Distribution Automation
- DER Distributed Energy Resources
- DAT Digital Audio Tape
- DC Data Concentrator
- DCU Data Concentrator Unit
- DLMS Device Language message specification
- DMZ Demilitarized zone
- DT Distribution Transformer
- EMS Energy Management System
- FAQ Frequently Asked Question
- FIFO First in First Out
- FRTU Field Remote Terminal Units
- GPS Global positioning system
- GUI Graphical User Interface

- HAN Home Area Network
- HES Head End System
- IDS Intrusion detection system
- IPS Intrusion prevention system
- IEC International Electro technical commission
- IT Information Technology
- LV Low Voltage
- MDAS Meter Data Acquisition System
- MDM Meter Data Management
- MOC Meter Operations Center
- MTTF Mean time to failure
- MV Medium voltage
- MB Mega Byte
- NEA Nepal electricity Authority
- NMM Network Management Module
- NOC Network Operation Center
- OEM Original Equipment Manufacturer
- OFC Optical Fiber Cable
- OFDM Orthogonal Frequency Division Multiplexing
- OMS Outage Management System Module
- OTA Over the Air
- PDH Plesiochronous digital hierarchy
- PLC Power Line Communications
- PQM Power Quality Monitor
- RAM Random Access Memory
- RF Radio Frequency
- RFP Request for Proposal
- RTC Real Time Clock
- SAN Storage area network
- SLA Service Level agreement
- SDH Synchronous Digital Hierarchy
- SNTP Simple Network Time Protocol
- TOU Time of Usage
- TAT Turnaround Time
- TTF Time to first failure
- TB Tera Byte
- VEE Validation, Estimation, and Editing
- XML Extended Markup Language