(A Wholly Owned Subsidiary of Power Finance Corporation Ltd. -

A Government of India Undertaking)

invites

Request for Proposal

on behalf of

Orissa Power Transmission Corporation Limited

For

"For Selection of Smart Grid Implementing Agency (SGIA) for implementation of Smart Grid in Rourkela City"

Volume-III

(Technical Specification)

Registered Office

1st Floor, "Urjanidhi" 1, Barakhambha Lane, Connaught Place,

New Delhi – 110 001

Corporate Office

9th Floor (A Wing) Statesman House, Connaught Place, New Delhi-110001

May 2nd, 2019

Table of Contents of RfP (Volume III)

A. AMI FIELDHARDWARE& SOFTWARE

1. TECHNICAL SPECIFICATION OF SINGLE PHASE WHOLE CURRENT SMART METER

Technical specifications for whole current a.c. single phase two wire smart energy meter of accuracy class 1.0 with bi-directional communication facility suitable for advanced metering infrastructure (AMI)

1.1. SCOPE

The specification covers the design, manufacturing, testing, supply and delivery of AC whole current 1 phase 2 wires Smart Energy Meter with bi directional communication facility. The meter shall be suitable for Advanced Metering Infrastructure(AMI).The meter shall communicate with DCU/Access Point/HES on any one of the communication technologies mentioned in IS16444,asperthe requirement of the utility.

1.2. BASIC FEATURES

The Smart Meter would have the following minimum basic features-

- Measurement of electrical energy parameters
- Bidirectional Communication
- Integrated Load limiting switch
- Tamper event detection, recording and reporting
- Power event alarms such as loss of supply, low/high voltage
- Remote firm ware upgrade
- Net metering features
- On demand reading

1.3. GENERAL STANDARDS APPLICABLE FOR METERS

Unless otherwise specified elsewhere in this specification, the performance and testing of the meters shall conform to the following standards with latest amendments thereof:

S.No.	Standard No.	Title
1	IS 13779with latest amendments	AC StaticWatt-hourMeterclass1&2
2	IS 16444with latest amendments	A.C. Static Direct Connected Watt Hour Smart Meter Class 1and 2- Specification
3	IS 15884with latest amendments	Alternating Current Direct Connected Static Prepayment Meters for Active Energy(Class 1 and 2)- Specification
4	IS 15959Part 1 & Part2 with latest amendments	Data Exchange for Electricity Meter Reading, Tariff and Load Control- Companion Standards

1.4. COMMUNICATION

Meter shall have ability to communicate with DCU/Access Point/HES on any one of the technologies mentioned in IS16444 in a secure manner, as per the site conditions and as per design requirement of AMI Implementing agency. In case of GPRS/3G/4G based meter, the meter shall accommodate SIM card of any service provider. In case of Plug in type communication module, the meter shall log communication module removal/non-responsive event with snapshot.

1.4.1 Remote Load control facility would be as per IS 16444.

1.5. OTHER SPECIFICATIONS

Particulars	**Specification**
Applicable Standards	The meters shall comply with IS 16444 for all requirements. Those parameters which are not covered in IS 16444 have been specifically mentioned in this specification.
Reference Voltage	As per relevant IS
Current Rating	5-30A/ 10-60A (asper the requirement of the utility)
Starting Current	As per IS 16444
Accuracy	Class1.0as per IS 16444
Limits of error	As per IS 16444
Operating Temperature range	As per IS 16444
Humidity	As per IS 16444
Frequency	As per IS 16444
Influence Quantities	As per IS 16444
Power Consumption of Meter	As per IS 16444
Current and Voltage Circuit	As per IS 16444
Running at No Load	As per IS 16444
Test output device	As per IS 16444
Meter Display	As per IS 16444
Name Plate & marking Meter Display	As per IS16444
Parameters to be measured	As per IS16444/As per IS 15959Part-2
Maximum Demand resetting	As per IS 15959 Part 2
Time of Use registers	As per IS 15959 part 2
Power Quality Information	As per IS 15959 part 2
LED/LCD Indicators	As per IS 16444
Load Survey/Interval Data	As per IS 15959 part 2
Tamper/ Event Recording	As per IS 15959 part 2
Measuring Elements	As per IS 16444
Alarm	As per IS 16444/ 15959 Part 2
Load Control	As per IS 16444
Connect/Disconnect and status of load switch	As per IS 16444

Particulars	Specification
Programmability	As per IS 16444
Communication	As per IS 16444.
Communication Protocol	As per IS 16444
Remote Firmware upgrade	As per IS 15959 part 2
Real Time Clock (RTC)	As per IS 16444/ IS 15884The clock day/date setting and synchronization shall only be possible through password/Key code command from one of the following: • From remote server through suitable secured communication network. Time synchronisation should be done using server end GPS Time input. • Hand Held Unit (HHU) or Meter testing work bench and this shall need password enabling for meter;
Data Retention	As per CEA regulations
Battery Backup	Meter shall be supplied with separate battery backup for RTC.
Guarantee	Manufacturer Shall undertake a guarantee to replace meter up to a period of 60 months from the date of supply. The meter which are found defective/inoperative within the guarantee period, these defective/inoperative meters shall be replaced within one month of receipt of report for such
First Breath(power on) and Last gasp (power off) condition detection and communication	As per IS 16444

DATADISPLAYFACILITY(AUTO/MANUAL)

Data Display shall be in three modes-

- Auto Scroll
- Scroll with Push Button
- High Resolution (Shall display energy values with resolution of 2 digits before decimal and 3 digits after decimal in push button mode)

The display order shall be: AutoScroll

- Cumulative Active Energy kWh along with legend.
- Current calendar month MD in kW with legend.
- Instantaneous voltage
- Instantaneous current

These parameters should be displayed on the LCD/LED continuously for a period of 15seconds on Auto scroll. In case of power failure, the meter should display above parameters with push button.

Scroll with Push-button Internal diagnostics

- Cumulative kWh Date
- Real Time
- Voltage in (V)
- Current (I)
- Power (kW)
- Current month MD in kW
- Last month cumulative kWh
- Last month MD in kW
- Last month MD occurrence Date
- Last month MD occurrence Time
- Meter Serial Number

The meter's display should return to default display mode (continues auto scroll) if pushbutton is not operated for more than10 seconds.(The order of display may be revised as per requirement of the utility)

1.6. ANTI TAMPER FEATURES

The meter shall continue recording energy under any tamper condition and would log the event and send alarm at Head End System after detection of the defined theft features as per IS 15959 Part2.

(Optional test as per requirement of utility: The Meter shall be immune under external magnetic influences as per CBIP 325. Meter shall be tested for high voltage discharge (Spark) up to35 KV as per CBIP 325.)

1.7. TESTS

1.7.1. **Type Tests & Test Certificates**

Smart meter shall be type tested for all the type tests as per IS:16444 (latest version) in a third party independent lab. The number of sampling for testing of meters and criteria for conformity would be as per IS 16444.

Necessary copies of test certificates shall be submitted as per agreement with the utility.

1.7.2. Routine & Acceptance Tests

The Factory Acceptance and Routine tests shall be carried out as per IS 16444. A part from above test, meter shall be also be tested for all functional requirement through communication as part of acceptance test

1.8. GENERAL & CONSTRUCTIONAL REQUIREMENTS

1.8.1. Meter Shall be BIS marked as per IS16444.

1.8.2. General & construction requirement shall be as per IS 16444/IS 13779

1.8.3. In Home Display (IHD) shall be optional and the specifications of the same would be as per agreement between the bidder and the utility.

1.9. METER BASE & COVER-

Meter base & cover shall be as per IS 16444/ IS 13779.The meter Base & cover shall be break to open design. The material for meter base and cover shall be made of high grade polycarbonate.

1.10. TERMINAL BLOCK & COVER -

As per IS16444/IS13779

1.11. DESIGN

Voltage circuit, sealing arrangement, terminal block, terminal cover and name plate etc. shall be in accordance with IS-16444 (latest version).

The meter shall be compact and reliable in design, easy to transport and immune to vibration and shock involved in transportation and handling.

1.12. CIRCUITRY

As per IS16444

The supplier should submit the details of source/agencies from whom purchase of various components of meters used by them to the utility/purchaser.

1.13. NAME PLATE AND MARKING

The meter should bear a name plate clearly visible, effectively secured against removal and indelibly/distinctly marked in accordance with relevant IS. In addition, in the middle of the name plate the words "Name of the Utility", purchase order no. & year/month of manufacturing shall either be punched or marked indelibly. The rating plate information shall be as per relevant IS.

1.14. CONNECTION DIAGRAM:

Asper IS16444

1.15. FIXING ARRANGEMENTS:

The meter shall be mounted type. The Meter should have three fixing holes, one at top and two at the bottom. The Top hole should be such that the holding screw is not accessible to the consumer after fixing the meters. The lower screws should be provided under sealable terminal cover. The requisite fixing screws shall be supplied with each meter.

1.16. SEALING ARRANGEMENT:

Arrangements shall be provided for proper sealing of the meter cover so that access to the working parts shall not be possible without breaking the seal.

The sealing arrangement and number of seals shall be as per relevant IS/requirement of utility.

1.17. METER BOX:

The Meter Box would be provided as per requirement of the utility/purchaser.

1.18. PACKING

The meters shall be suitably packed for vertical/horizontal support to withstand handling during transportation. The meter shall be packed appropriately to ensure safe transportation, handling, identification and storage. All packing materials shall be as per environment law in force. The primary packing shall ensure protection against humidity, dust, grease and safeguard the meter's performance until its installation. The secondary packing shall provide protection during transportation. The packing case shall indicate "Fragile in nature" and direction of placement of box. Each packing shall indicate marking details like Manufacturer's name, S.No. of meters, quantity etc.

1.19. TRANSPORTATION

The meter shall be compact in design. The meter block unit shall be capable of with standing stresses likely to occur in actual service and rough handling during transportation. The meter shall be convenient to transport and immune to shock and vibration during transportation and handling.

The meter should not be exposed to undue shock and mishandling during transportation. The stacking of box inside transport media should be such as to avoid their free movement. The packing should also be protected from rain and dust by transport media. The Bidder shall be responsible for any damage during transit due to inadequate or improper packing.

1.20. TESTING AND MANUFACTURING FACILITIES AT MANUFACTURER'S PLACE

The manufacturer shall have NABL accredited laboratory to ensure accurate testing calibration as per IS 13779 for acceptance test.

1.21. INSPECTION

All meters shall be duly tested and sealed by the firm at their premises prior to inspection. Manufacturer seal may be provided on one side of meter. For the other side, the seal with engrave as Utility name may be sent in a pack for provision by utility after completion of test by the utility & after receipt of the meter.

The utility/purchaser may inspect the meter randomly as per sampling plan for acceptance test as per IS 16444. The meters shall be tested for all functional requirements as part of acceptance test as per IS 16444. After testing, these sample meters shall be additionally sealed and would be kept in safe lock for verification if needed.

2. TECHNICAL SPECIFICATION OF THREE PHASE WHOLE CURRENT SMART METER

TECHNICAL SPECIFICATIONS FOR WHOLE CURRENT A.C. THREE PHASE FOUR WIRE SMART ENERGY METER OF ACCURACY CLASS 1.0 WITH Bi DIRECTIONAL COMMUNICATION FACILITY SUITABLE FOR ADVANCED METERING INFRASTRUCTURE (AMI)

2.1. SCOPE

The specification covers the design, manufacturing, testing, supply and delivery of AC whole current 3 phase 4 wires Smart Energy Meter with bidirectional communication facility. The meter shall be suitable for Advanced Metering Infrastructure (AMI). The meter shall communicate with Data Concentrator Unit (DCU)/Access Point/HES on any one of the communication technologies mentioned in IS 16444, as per the requirement of the utility/authorized system integrator.

2.2. BASIC FEATURES

The Smart Meter would have the following minimum basic features-

- Measurement of electrical energy parameters
- Bidirectional Communication
- Integrated Load limiting switch/relay
- Tamper event detection, recording and reporting
- Power event alarms such as loss of supply, low/high voltage
- Remote firmware upgrade
- Net metering features
- On demand reading

2.3. GENERAL STANDARDS APPLICABLE FOR METERS

Unless otherwise specified else where in this specification, the performance and testing of the meters shall conform to the following standards with latest amendments thereof:

S.No.	Standard No.	Title
1	IS 13779with latest amendments	AC StaticWatt-hourMeterclass1&2
2	IS 16444with latest amendments	A.C. Static Direct Connected Watt Hour Smart Meter Class 1and 2- Specification
3	IS 15884with latest amendments	Alternating Current Direct Connected Static Prepayment Meters for Active Energy(Class 1 and 2)- Specification
4	IS 15959Part 1 & Part2 with latest amendments	Data Exchange for Electricity Meter Reading, Tariff and Load Control- Companion Standards

2.4. COMMUNICATION

Meter shall have ability to communicate with Data Concentrator Unit(DCU)/Access Point/HES on any one of the technologies mentioned in IS 16444 in a secure manner, as per the site conditions and as per design requirement of AMI Implementing agency. In case of GPRS/3G/4G based meter, the meter shall accommodate SIM card of any service provider. In case of Plug in type communication module, the meter shall log communication module removal/non-responsive event with snapshot.

Remote Load control facility would be as per IS 16444.

2.5. OTHER SPECIFICATIONS

Particulars	Specification
Applicable Standards	The meters shall comply with IS 16444 for all requirements. Those parameters which are not covered in IS 16444 have been specifically mentioned in this specification.
Reference Voltage	Asper relevant IS
Current Rating	5-30A/ 10-60A (asper the requirement of the utility)
Starting Current	As per IS 16444
Accuracy	Class1.0as per IS 16444
Limits of error	As per IS 16444
Operating Temperature range	As per IS 16444
Humidity	As per IS 16444
Frequency	As per IS 16444
Influence Quantities	As per IS 16444
Power Consumption of meter	As per IS 16444
Current and Voltage Circuit	As per IS 16444
Running at No Load	As per IS 16444
Test output device	As per IS 16444
Meter Display	As per IS 16444
Name Plate & marking Meter Display	As perIS16444
Parameters to be measured	Asper IS16444/As per IS 15959Part-2
Maximum Demand resetting	As per IS 15959 Part 2
Time of Use registers	As per IS 15959 part 2
Power Quality Information	As per IS 15959 part 2
LED/LCD Indicators	As per IS 16444
Load Survey/Interval Data	As per IS 15959 part 2
Tamper/ Event Recording	As per IS 15959 part 2
Measuring Elements	As per IS 16444
Alarm	As per IS 16444/ 15959 Part 2
Load Control	As per IS 16444
Connect/Disconnect and status of load switch	As per IS 16444

Particulars	Specification
Programmability	As per IS 16444
Communication	As per IS 16444.
Communication Protocol	As per IS 16444
Remote Firmware upgrade	As per IS 15959 part 2
Real Time Clock(RTC)	As per IS 16444/ IS 15884The clock day/date setting and synchronization shall only be possible through password/Key code command from one of the following: • From remote server through suitable communication network. • Hand Held Unit (HHU) or Meter testing work bench and this shall need password enabling for meter; (The methodology for the synchronization w o u l d b e a s per requirement of utility)
Data Retention	As per CEA regulations
Battery Backup	Meter shall be supplied with separate battery backup for RTC.
Guarantee	Manufacturer Shall undertake a guarantee to replace meter up to a period of 60 months from the date of supply. The meter which are found defective/inoperative within the guarantee period, these defective/inoperative meters shall be replaced within one month of receipt of report for such
First Breath(power on) and Last gasp (power off) condition detection and communication	As per IS 16444

2.5.1. DATADISPLAYFACILITY(AUTO/MANUAL)

Data Display shall be in three modes-

- Auto Scroll
- Scroll with Push Button
- High Resolution (Shall display energy values with resolution of 2 digits before decimal and 3 digits after decimal in push button mode)

The display order shall be: AutoScroll

- Cumulative Active Energy kWh along with legend.
- Current calendar month MD in kW with legend.
- Instantaneous voltage
- Instantaneous current

These parameters should be displayed on the LCD/LED continuously for a period of 15seconds on Auto scroll. In case of power failure, the meter should display above parameters with push button.

Scroll with Push-button Internal diagnostics

- Cumulative kWh Date
- Real Time
- Voltage in (V)
- Current (I)
- Power (kW)
- Current month MD in kW
- Last month cumulative kWh
- Last month MD in kW
- Last month MD occurrence Date
- Last month MD occurrence Time
- Meter Serial Number

The meter's display should return to default display mode (continues auto scroll) if push button is not operated for more than10 seconds. (The order of display may be revised as per requirement of the utility)

2.6. ANTI TAMPER FEATURES

The meter shall continue recording energy under any tamper condition and would log the event and send alarm at Head End System after detection of the defined theft features as per IS 15959 Part2.

(Optional test as per requirement of utility: The Meter shall be immune under externalmagneticinfluencesasperCBIP325. Meter shall be tested for high voltage discharge (Spark) up to 35 KV as per CBIP 325.)

2.7. TESTS

1.7.3. **Type Tests & Test Certificates**

Smart meter shall be type tested for all the type tests as per IS:16444 (latest version) in a third party independent lab. The number of sampling for testing of meters and criteria for conformity would be as per IS 16444.

Necessary copies of test certificates shall be submitted as per agreement with the utility.

1.7.4. Routine & Acceptance Tests

The Factory Acceptance and Routine tests shall be carried out as per IS 16444. A part from above test, meter shall be also be tested for all functional requirement through communication as part of acceptance test

2.8. GENERAL & CONSTRUCTIONAL REQUIREMENTS

1.8.4. Meter Shall be BIS marked as per IS16444.

1.8.5. General & construction requirement shall be as per IS 16444/IS 13779

1.8.6. In Home Display (IHD) shall be optional and the specifications of the same would be as per agreement between the bidder and the utility.

2.9. METER BASE & COVER-

Meter base & cover shall be as per IS 16444/ IS 13779.The meter Base & cover shall be break to open design. The material for meter base and cover shall be made of high grade polycarbonate.

2.10. TERMINAL BLOCK & COVER -

Asper IS16444/IS13779

2.11. DESIGN

Voltage circuit, sealing arrangement, terminal block, terminal cover and name plate etc. shall be in accordance with IS-16444 (latest version).

The meter shall be compact and reliable in design, easy to transport and immune to vibration and shock involved in transportation and handling.

2.12. CIRCUITRY –

As per IS16444

The supplier should submit the details of source/agencies from whom purchase of various components of meters used by them to the utility/purchaser.

2.13. NAME PLATE AND MARKING

The meter should bear a name plate clearly visible ,effectively secured against removal and indelibly/distinctly marked in accordance with relevant IS. In addition, in the middle of the name plate the words “Name of the Utility”, purchase order no. & year/month of manufacturing shall either be punched or marked indelibly. The rating plate information shall be as per relevant IS.

2.14. CONNECTION DIAGRAM:

Asper IS16444

2.15. FIXING ARRANGEMENTS:

The meter shall be mounted type. The Meter should have three fixing holes, one at top and two at the bottom. The Top hole should be such that the holding screw is not accessible to the consumer after fixing the meters. The lower screws should be provided under sealable terminal cover. The requisite fixing screws shall be supplied with each meter.

2.16. SEALING ARRANGEMENT:

Arrangements shall be provided for proper sealing of the meter cover so that access to the working parts shall not be possible without breaking the seal.

The sealing arrangement and number of seals shall be as per relevant IS/requirement of utility .

2.17. METER BOX:

The Meter Box would be provided as per requirement of the utility/purchaser.

2.18. PACKING

The meters shall be suitably packed for vertical/horizontal support to withstand handling during transportation. The meter shall be packed appropriately to ensure safe transportation, handling, identification and storage. All packing materials shall be as per environment law in force. The primary packing shall ensure protection against humidity, dust, grease and safeguard the meter’s performance until its installation. The secondary packing shall provide protection during transportation. The packing case

shall indicate “Fragile in nature” and direction of placement of box. Each packing shall indicate marking details like Manufacturer’s name, S.No. of meters, quantity etc.

2.19. TRANSPORTATION

The meter shall be compact in design. The meter block unit shall be capable of withstanding stresses likely to occur in actual service and rough handling during transportation. The meter shall be convenient to transport and immune to shock and vibration during transportation and handling.

The meter should not be exposed to undue shock and mishandling during transportation. The stacking of box inside transport media should be such as to avoid their free movement. The packing should also be protected from rain and dust by transport media. The Bidder shall be responsible for any damage during transit due to inadequate or improper packing.

2.20. TESTING AND MANUFACTURING FACILITIES AT MANUFACTURER’S PLACE

The manufacturer shall have NABL accredited laboratory to ensure accurate testing calibration as per IS 13779 for acceptance test.

2.21. INSPECTION

All meters shall be duly tested and sealed by the firm at their premises prior to inspection. Manufacturer seal may be provided on one side of meter. For the other side, the seal with engrave as Utility name may be sent in a pack for provision by utility after completion of test by the utility & after receipt of the meter.

The utility/purchaser may inspect the meter randomly as per sampling plan for acceptance test as per IS 16444. The meters shall be tested for all functional requirements as part of acceptance test as per IS 16444. After testing, these sample meters shall be additionally sealed and would be kept in safe lock for verification if needed.

Network Items:

Sl.	Specification		
20	Internet Group Management Protocol (IGMP)		
21	IEEE 802.1ABLinkLayerDiscoveryProtocol (LLDP)		
22	Multicast VLAN to allow multiple VLANs to receive the same IPv4 or IPv6 multicast traffic		
23	Data Center Bridging (DCB) protocols support including IEEE 802.1Qbb Priority Flow Control (PFC), Data Center Bridging Exchange (DCBX), and IEEE 802.1QazEnhancedTransmission Selection (ETS) for converged applications		
24	Transparent Interconnection of Lots of Links (TRILL) support to increase the scale of enterprise data centers		
25	EVB/VEPA support to provide connectivity into the virtual environment fora data center-ready environment		
26	Shall have VX LAN VTEP support for virtualized environments with upto4000 tunnels		
27	**Layer 3 Features (any additional licenses required shall be included)**		
28	Static RoutingforIPv4 and IPv6		
29	RIP forIPv4 (RIPv1/v2) and IPv6 (RIPng)		
30	OSPF forIPv4 (OSPFv2)and IPv6 (OSPFv3)		
31	IS-IS forIPv4 and IPv6 (IS-ISv6)		
32	Border GatewayProtocol4withsupportforIPv6 addressing		
33	Policy-based routing		
34	Multi protocol Extensions forBGP-4		
35	Routing table size ofminimum100K(IPv4)and 50K(IPv6)entries		
	QoS and Security Features		
36	Access Control Lists for filtering traffic to prevent unauthorized users from accessing the network		
37	Congestion avoidance using Weighted Random Early Detection (WRED)		
38	Powerful QoS feature supporting Strict Priority Queuing (SP), Weighted Fair Queuing(WFQ), Weighted Deficit Round Robin(WDRR), SP+WDRR, Ingress Rate Limiting		
39	IEEE 802.1XPortBased Network Access Control		
40	DHCP SnoopingsupportincludingOption82		
41	Port security, Directed Broadcast Control		
	Management Features		
41	Configuration through secure command-line interface (CLI) over Telnet & SSH		
42	SNMPv1, v2, and v3		
43	sFlow (RFC3176) or equivalent for traffic analysis		
44	FTP and TFTP support		

Sl.	Specification		
45	Port mirroring to enable traffic on a port to be simultaneously sent to a network analyser for monitoring		
46	RADIUS or TACACS+ for switch security access administration		
47	Network Time Protocol(NTP)or equivalent support		
48	Shall have Ethernet OAM-Connectivity Fault Management(IEEE 802.1AG)and Ethernet in the First Mile (IEEE802.3AH)capability		
49	Shall support Open Flow protocol capability to enable software-defined networking(SDN) fromDay1		
50	Shall allow the separation of data (packet forwarding) and control (routing decision) paths, to be controlled by an external SDN Controller, utilizing Open flow protocol		
51	Shall support real-time telemetry analysis		
	OEM Criteria		
51	OEM of the proposed solution should be listed in Leaders Quadrant of Gartner's latest report for Enterprise LAN or DC Networking. All switches and routers must be of the same OEM.		
	CORE ROUTER		
	Architecture		
1	Router shall have multi-core processors providing robust routing and security		
2	Router shall have two 10/100/1000 Mbps routed ports(RJ-45)and two Gigabit SFP Ports		
3	The router shall have two 10-GigabitSFP+ ports for 10 G Scalability		
4	The router shall have redundant power supplies		
5	The router shall be 19"Rack Mountable (any hardware required shall be offered)		
	Performance		
6	The router forwarding performance shall be minimum10Mpps		
7	The router shall have Hardware-based encryption acceleration		
8	The router shall have an encryption performance of 4Gbps		
9	The router shall have minimum40Gbps fabric capacity		
10	Minimum 4000K IPv4 and 2000K IPv6 route entries		
	Features (Any licenses required shall be included)		
11	The router shall support the following IP Routing Protocols(IPv4)-Static Routing, RIP, OSPF, BGP, and IS-IS		

Sl.	Specification		
12	The router shall support the following IP Routing Protocols(IPv6)-Static Routing, RIPng, OSPFv3, BGP+, and IS-ISv6		
13	The router shall support Multi cast routing protocols for IPv4 and IPv6 such as PIM-DM, and PIM-SM.		
14	The router shall support Policy-based routing		
15	The router shall have QoS features including Traffic policing, shaping, Congestion management, congestion avoidance etc		
16	The router shall have embedded security capabilities like Firewall, IPSec, ACL Filtering etc		
17	The router shall provide IPv6 transition mechanisms like NAT-PT, Tunneling etc		
18	Dynamic VPN Capability for ease of VPN deployment		
19	Router shall have integrated/external WAN traffic optimization features		
	Management		
20	SNMP V1/V2c/V3, RMON, sFlow/Net flow		
21	RADIUS/TACACS+ for management security		
22	Integrated console port (CLI)provided with console cable		
23	Shall have the capability to extend the control plane across minimum two nos of such routers making it a virtual routing fabric, enabling interconnected routers to performasLayer-3 router. Module/cable for creating virtual routing fabric shall be offered.		
	OEM Criteria		
24	OEM of the proposed solution should be listed in Leaders Quadrant of Gartner's latest report for Enterprise LAN or DC Networking. All switches and routers must be of the same OEM.		
FIELDOFFICE ROUTER			
Sl.No.	**Specification**		
	Architecture		
1	Router shall have RISC-based processors providing robust routing and security		
2	Router shall have two 10/100/1000 Mbps routed ports(RJ-45)and one Giga bit SFP Routed Port		
3	The router shall have three WAN Interface card slots supporting LAN/WAN/Voice interface cards-Ethernet, V.35, E1, FXS/FXO, 3GModuleetc		
4	The router shall support internal/external redundant power supplies		

Sl.	Specification		
5	The router shall be 19"RackMountable (any hardware required shall be offered)		
	Performance		
6	The router forwarding performance shall be minimum2Mpps		
7	The router shall have Hardware-based encryption acceleration. Minimum1000 IPSec Tunnels should be supported		
8	The router shall have an encryption performance of1Gbps		
9	The router should have Field-programmable gate array (FPGA) to improve the uplink performance and router should have the ability to ease utilization of the main processor by transmittingLayer2 packets directly via the Multi Gigabit Fabric.		
10	Minimum 200K IPv4 and 200K IPv6 route entries		
	Features (Any licenses required shall be included)		
11	The router shall support the following IP Routing Protocols (IPv4)-Static Routing, RIP, OSPF, BGP, and IS-IS		
12	The router shall support the following IP Routing Protocols (IPv6)-Static Routing, RIPng, OSPFv3, BGP+, and IS-ISv6		
13	The router shall support Multicast routing protocols for IPv4 and IPv6 such as PIM-DM, and PIM-SM.		
14	The router shall support Policy-based routing		
15	The router shall have QoS features including Traffic policing, shaping, Congestion management, congestion avoidance etc		
16	The router shall have embedded security capabilities like Firewall, IPSec, ACL Filtering etc		
17	The router shall provide IPv6 transition mechanisms like NAT-PT, Tunneling etc		
18	Dynamic VPN Capability for ease of VPN deployment		
19	Router shall have integrated/external WAN traffic optimization features		
	Management		
20	SNMP V1/V2c/V3, RMON, sFlow/Net flow		
21	RADIUS/TACACS+ for management security		
22	Integrated console port (CLI)provided with console cable		
23	Shall have the capability to extend the control plane across minimum two nos of such routers making it a virtual routing fabric, enabling interconnected routers to performasLayer-3router.Module/cable for creating virtual routing fabric shall be offered.		
	OEM Criteria		

Sl.	Specification		
24	OEM of the proposed solution should be listed in Leaders Quadrant of Gartner's latest report for Enterprise LAN or DC Networking. All switches and routers must be of the same OEM.		
FIELDOFFICESWITCH			
Sl. No.	**Specification**		
	Architecture		
1	19"RackMountable with mounting kit		
2	24 RJ-45 autosensing10/100/1000ports and 4 Gigabit SFP ports		
3	Shall have switchingcapacityof56 Gbps		
4	Shall have upto 41 millionpps switching throughput		
5	The Switch shouldsupport32000 MAC address or equivalent		
6	The switch should have Routing table size of4000entries(IPv4), 2000 entries(IPv6)		
	Quality of Service (QoS)		
7	The switch should support Traffic prioritization(IEEE802.1p)to allow real-time traffic classification into eight priority levels mapped to eight queues		
8	The switch should support Layer4 prioritization to enable prioritization based on TCP/UDP port numbers		
9	The switch should Provide graceful congestion management		
	IPv6 Feature		
10	The switch should support Dual stack(IPV4 and IPV6) to transition fromIPv4 to IPv6, supporting connectivity for both protocols		
11	The switch should support MLD snooping to forward IPv6 multi cast traffic to the appropriate interface or equivalent		
12	The switch should support ACL and QoS forIPv6 network traffic or equivalent		
13	The switch should support static and RIPng/OSPF forIPv6		
	Security		
14	The switch should support Ra guard, DHCPv6 protection, dynamic IPv6 lockdown, and ND snooping		
	Convergence		
15	The switch should support IP multicast routing and PIMS parse and Dense modes to route IP multi cast traffic		
16	The switch should support IP multi cast snooping and data-driven IGMP		
17	The switch should support IEEE 802.1ABLLDP and LLDP-MED		
	Resiliency and high availability		

Sl.	Specification		
18	The Switch should create one virtual resilient switch from four switches and attached the network devices using standard LACP for automatic load balancing and high availability to simplify network operation by reduce the need for complex protocols like Spanning Tree Protocol(STP), Equal-Cost Multipath(ECMP), and VRRP		
19	The switch should support Virtual Router Redundancy Protocol(VRRP)		
20	The switch should support IEEE 802.1s Multiple Spanning Tree		
21	The switch should support IEEE 802.3ad link-aggregation-control protocol (LACP)and port trunking		
	Management		
22	The switch should support SNMPv1, v2, and v3		
23	The switch should support Zero-Touch Provisioning(ZTP)		
24	The switch should support Dual flash images		
25	Find-Fix-Informor EAA or equivalent		
26	The switch should support RMON, XRMON, and sFlow		
27	The switch should support Unidirectional link detection(UDLD)/Equivalent		
	Layer2 switching		
28	The switch should support IEEE 802.1Q (4094V LAN IDs) and 2KV LANs simultaneously		
29	The switch should support MVRP		
30	The switch should support encapsulation (tunneling) protocol for over lay network that enables amore scalable virtual network deployment		
	Layer3 services		
31	The switch should support DHCP server		
	Layer3 routing		
32	The switch should support static IP routing as well as Policy based Routing.		
	Security		
33	The switch should support IEEE 802.1X. Multiple IEEE802.1Xusers per port must be supported		
34	The switch should support Access control lists(ACLs)-Minimum3KACLs to be supported		
35	The switch should support RADIUS/TACACS+		
36	The switch should support Secure shell and SSL		
37	The switch should support Identity-driven ACL		
	OEM Criteria		

Sl.	Specification		
38	OEM of the proposed solution should be listed in Leaders Quadrant of Gartner's latest report for Enterprise LAN or DC Networking. All switches and routers must be of the same OEM.		

B. SCADA FIELD HARDWARE& SOFTWARE

1. HARDWARE REQUIREMENTS FOR SCADA/DMS

1.1. Introduction

This section articulates the hardware requirements for the SCADA/DMS system. The conceptual hardware configuration diagram of SCADA/DMS control centre is indicated in Figure-1 of section 1 chapter1. The bidders are encouraged to optimise the hardware for servers where SCADA, DMS & ISR applications can be combined or distributed in any combination with adequate redundancy. However quantity of servers shall be as per detailed bill of quantities for SCADA/DMS defined in section 8. Bidder shall assess the adequacy of hardware specified in the BOQ & if any additional hardware is required to meet all the requirements of the technical specifications, the same shall also be included in the offer. The Bidder shall offer the minimum hardware configuration as specified here for various equipment, however if required, higher end hardware configurations shall be offered to meet all the requirements of the technical specification. The redundant hardware such as servers (Except DTS, development server), CFE, etc shall work in hot standby manner. If the SCADA/DMS control centre is collocated with DC/DR centre, then IT infrastructure such as LAN/WAN security & networking hardware shall be used. However, it is necessary to ensure that the functional requirements, availability & performance aspects are met as per SCADA/DMS-OMS system specification.

1.2. General 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 such as computers, computer peripherals/accessories etc. and networking products proposed and implemented shall conform to latest products based on industry standard. All hardware shall be of reputed make.

All servers and workstations shall include self-diagnostic features. On interruption of power they shall resume operation when power is restored without corruption of any applications.

The hardware shall be CE/FCC or equivalent international standard compliance. The specification contains minimum hardware requirement. However, the contractor shall provide hardware with configuration equal or above to meet the technical functional & performance requirement. Any hardware /software that is required to meet functional, performance & availability requirement shall be provided by Contractor/SGIA & the same shall be mentioned in the BOQ at the time of bid. If not mentioned at the time of bid, contractor shall provide the same without any additional cost to the owner

The proposed system shall be designed for an open & scalable configuration, to ensure the inter-compatibility with other systems of the UTILITY, the future smooth expansion as well as the easy maintainability. The proposed hardware configuration should be extended by adding CPU processors / memory boards / disks etc in delivered units or additional units for capacity extension.

The configuration of the SCADA/DMS-OMS shall comprise a distributed computing environment with open systems architecture. The system architecture shall be open internally and externally to hardware or application software additions, whether supplied by the original supplier of the SCADA/DMS or obtained from third party vendors, both for capacity expansion and for upgrading functionality, without affecting existing SCADA/DMS components or operation.

To be recognized as a true open computer system, all internal communications among the SCADA/DMS-OMS Servers and all external communications between the SCADA/DMS and other computer systems shall be based on widely accepted and published international or industry standards which are appropriate and relevant to the open systems concept or should have a field proven acceptance among

utilities. This applies to the operating system, database management system, and display management system, as well as to APIs providing standardized interfacing between System software and application software. The contractor/SGIA should ensure that at the time of final approval of hardware configuration/BOQ, all the above hardware are current industry standard models and that the equipment manufacturer has not established a date for termination of its production for said products. Any hardware changes proposed after contract agreement shall be subject to the following: -

Such changes/updates shall be proposed and approval obtained from Employer along with the approval of Drawings/documents.

The proposed equipment shall be equivalent or with better features than the equipment offered in the Contract.

Complete justification along with a comparative statement showing the original and the proposed hardware features/parameters including technical brochures shall be submitted to the Employer for review and approval.

Changes/updates proposed will be at no additional cost to the Employer/Purchaser.

1.3. Hardware Configuration

In this technical specification all hardware has been broadly classified as server and Peripheral device. The term "server" is defined as any general-purpose computing facility used for hosting SCADA, DMS, OMS & ISR 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 Operator Workstations, WAN router, LAN, Printer, , Time and Frequency system, External Auto loader, External Cartridge Magnetic tape drive, VPS, RTU/FRT U etc.

a. Servers

The OEM of servers shall be member of TPC/SPECMARK. Can be broadly classified into the following categories:

i. Application server
ii. SCADA/DMS/OMS
iii. ISR
iv. NMS
v. Web server
vi. Communication server
vii. Front –End server (Communication Front End) FEP(CFE), ICCP /Inter control centre communication server
viii. De –militarized server (DMZ)
ix. web server with load balancing
x. Training & development system server
xi. DTS #
xii. Developmental server #
xiii. Data recovery
xiv. DR/ Communication server ^

Sr. No.	Description of the features	Minimum Quantity of the features
1	Processor	Processor must be of latest generation and with highest clock speed and highest cache per core ratio.
2	Operating System	Latest version of OEM operating system shall be provided for each server, with required number of user license on each server
3	SPEC int& SPEC fp	As per the base runtime requirements of SPEC CPU 2006 Benchmarking Standards.
4	L3 cache	8 MB Minimum
5	Memory	Minimum 32 GB of ECC DDR3 Memory and scalable up to 512 GB memory(Memory slots free for expansion)
6	Hard Disk Drives	2*300GB SAS delivered, scalable upto 1 TB
7	Integrated SAS / RAID Controller	Integrated hardware RAID controller and should support hardware RAID 0, 1, 10, 5. Offered controller should have 512 MB battery backed cache.
8	Optical Drive	Server should be configured with single DVD-RW drive/ blu-ray R/W drive
9	Gigabit Ethernet ports	Server should be configured with 4*1Gigabit Ethernet ports
10	Storage Connectivity	Server should be configured with two dual port 8Gbps Fiber Channel adapter to connect to external storage.
11	USB ports	For connecting i/o devices
12	Redundant Power Supply	Server should be configured with Dual redundant power supplies with 80 PLUS Platinum certification
13	Failure Alerting Mechanism	The server should be able to alert impending failures on server component to administrator in order to avoid any downtime on the server due to actual failure
14	Management Console	Should support integrated management with remote presence, Server should be supplied with OEM Server. Management software/hardware and required ports
15	Warranty	Onsite Warranty 24*7 response time
16	RAS Feature	Should have RAS features such as Hot swappable disks, Hot pluggable/replaceable PCI Controllers, Power Supplies, Cooling fans etc.

Contractor shall provide cubicle mounted servers. The main & standby servers shall be provided with separate cubicles where each cubicle can be provided with one set of TFT monitor, keyboard, and mouse through KVM switch with retraceable tray.

1.4. Application servers

Redundant SCADA/DMS-OMS servers shall house SCADA/DMS-OMS application. Redundant ISR application shall be provided with common external memory for mass historical data storage and retrieval. The external memory shall comprise of multiple hot pluggable type hard disks configured in RAID configuration. (Except RAID-0) The external memory shall be connected either directly to the ISR server through SCSI /SAS interface or directly on the LAN (Network Attached Storage). Alternatively, the bidder may offer RAID with each server to meet the mass storage requirement in place of common external memory. The minimum requirement for external RAID for ISR servers is as below.

The SCADA shall include historical data storage configured to store historical data at the storage rates, for the required period of time, and for the Ultimate historical database sizes given in section 8.

a. Integrated SAS / RAID Controller - Integrated hardware RAID controller with LCD/LED status display and should support hardware RAID 0, 1, 10, 5. Offered controller should have 512 MB battery backed cache.
b. RAID Support- Should support RAID 0, 1, 10, 5, 6
c. On-line Expansion / RAID Group creation / Pool Expansion - System support online expansion of RAID Group or addition of new RAID Group. Must be able to add additional disks on the fly to expand the RAID group capacity or create new RAID Group.
d. Redundant controller
e. Host Interface: Fibre Channel connection per controller from the host side
f. Host Ports per Controller: Dual 2 Gb/s
g. Redundant Web / Active Directory Services Server shall host Web Applications for SCADA/DMS LAN and the DNS configuration
h. Redundant NMS server shall be provided to host NMS application

1.5. Communication Servers:

a. FEP (CFE) Server

The redundant FEP server shall be a functional unit that offloads the task of communication & pre - processing between RTUs/FRTUS/FPIs & SCADA/DMS servers. All RTUs/FRTUs/FPIs shall be connected to CFE through IEC 60870-5-104/101 link.. For any existing RTUs/FRTU/FPI that are to be integrated, interface must be available to use existing protocols. Free slots shall be made available inside the FEP server, so as additional communication boards can be plugged-in to meet the network future expansion. Each channel shall be assigned a different protocol and the front-end shall be able to manage several protocols in parallel.

The redundancy of front-end servers shall allow handling of RTUs/FRTUs/FPIs connected either through single channel or redundant channels. In both cases, one FEP server shall be able to take control of all RTUs/FRTUs/FPIs channels. In order to meet network's expansion behind the full capacity of a pair of FE servers, it shall be possible to connect additional FE servers' pairs to the LANs. Each communication line shall be able to support its own communication protocol. The CFE shall comply VPN / SSL based security for connecting with IEC 60870-5-104 &101 nodes on public networks. Further the nodes and CFE shall be self-certified by manufacturers as NERC/CIP compliant to comply with future smart grid requirements.

All FEPs shall not have open ports other than needed for protocol traffic / SCADA traffic, and shall have an audit trace of all login attempts / connection attempts. This FEP shall exchange data through secured SSL / VPN and encryption of protocol traffic whether it is a is public network or a dedicated one. The equipment should take control command from designated Master IP address only and no other IP.

All RTU/FRTU/FPI shall be connected to the SCADA/DMS Control Center.

RTU Communication Card / Module shall support VPN / SSL Security / Encryption of data coming to it through Public network, and then send over private & secure Utility network to the SCADA Control Center.

The Communication Servers shall be able to process time – stamped data and can be directly connected to GPS device for time synchronization.

b. **ICCP Server /inter control centre communication server**

Depending upon the protocol i.e. ICCP o other interco0ntrol centre protocol used as permissible as per this specification for , the server shall be called as ICCP or inter control centre communication server. The redundant ICCP//inter control centre communication server servers shall be installed at each SCADA/DMS control centres of eligible towns of the state and DR centre & shall be used to retrieve, transmit and process data to and from remote sources i.e. remote control centres. 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 server may also be used by UTILITY to exchange data with State Load Dispatch Centres (SLDC) of the state where scheme will be implemented for exchange of scheduling data.

c. **Network Management System (NMS) servers**

Redundant NMS servers shall be used for configuration management, fault management & performance monitoring of servers, workstations, routers & LAN equipments etc. Part of the above functions may be performed by other servers as per the standard design of offered product.

d. Web servers with Active directory:

Redundant Web servers with active directory LDAP, DNS shall be provided.

1.6. Demilitarized/ Security servers

a. Web servers with Firewalls and IPS:

Redundant Web servers shall be provided to allow the access of SCADA/DMS system data, displays by outside users. One router shall be provided which shall be connected to the external LAN/WAN communicating SCADA/DMS-OMS system. The external LAN/WAN users shall be able to access SCADA/DMS-OMS data through the Web server system through this router.

Web servers shall also be provided with host-based Intrusion prevention & detection system (IPS). The host-based IPS will be installed in both the Web-servers. The Network based IPS shall be supplied for both the SCADA/DMS-OMS dual LAN and DMZ dual LAN.

All necessary hardware & software for Web Servers with firewalls and IPS shall be supplied by the contractor.

b. Firewall:

Two firewalls shall be provided, one between Web servers & SCADA/DMS-OMS dual LAN and another between Web servers & Web server dual LAN. Specification of the firewall is given in the chapter for software requirements.

Contractor shall provide equivalent tools such as Apache etc for Web servers if UNIX or LINUX O/s is used to meet the security requirement as envisaged in the specification.

c. Training & development system server

1.7. DTS server;

A non - redundant server to host DTS applications shall be provided to impart the training.

1.8. Development server

A non- redundant server to host Developmental applications shall be provided

1.9. Data recovery cum communication server

Redundant DR server shall be provided with common external memory for mass historical data storage and retrieval. The external memory shall comprise of multiple hot pluggable type hard disks configured in RAID configuration. (Except RAID-0) The external memory shall be connected either directly to the ISR

server through SCSI /SAS interface or directly on the LAN (Network Attached Storage). Alternatively, the bidder may offer RAID with each server to meet the mass storage requirement in place of common external memory. The minimum requirement for external RAID for ISR servers is as below. The SCADA shall include historical data storage configured to store historical data at the storage rates, for the required period of time, and for the Ultimate historical database sizes given section 8.

1.10. Storage Array

a. Controller Cache: 512 MB per controller standard
b. Integrated RAID controller with an LCD/LED status display and 256 MB read/write battery-backed cache (expandable to 512 MB per controller).
c. Host Interface: Fibre Channel connection per controller from the host side
d. Host Ports per Controller: Dual 2 Gb/s FC enabled
e. RAID Levels(EXCEPT RAID 0)
f. Redundant Controller: Yes

1.11. Operator Workstations

The operator Workstation console shall be used as a Man Machine Interface (MMI) by despatcher for interacting with all SCADA/DMS system. Operator Workstation consoles shall also be used as development console to take up developmental/ maintenance activities such as generation/updation of database, displays etc & to impart training through DTS workstation consoles.

Each workstation shall consist dual monitors & single keyboard and a cursor positioning device/mouse.

Workstation consoles for development system shall also be available with single TFT monitor Operator workstation consists of a console driving single/ dual monitors as defined in the BOQ.

The user shall be able to switch the keyboard and cursor-positioning device as a unit between both monitors of console. The minimum hardware configuration of operator workstation shall be:

Spec int & Spec fp	As per the base runtime requirements of SPEC CPU 2006 Benchmarking Standards.
RAM	4 GB delivered, expandable upto 8GB
Processor Speed	3.0 GHZ each processor
Internal Auxilliary Memory	500GB delivered, expandable upto 1TB
Speakers	Two internal speakers
Interfaces	1GB dual Ethernet ports Min 4 USB Port Port for cartridge magnetic tape drive Graphic adapter cards(HDMI)
USER Interface	Three/Two(as per BOQ) 24" wide screen (16:9 aspect ratio), HD Resolution (1920x1080) TFT Colour monitors, keyboard & optical mouse
Mounting	Desktop mounting

The specification of Remote VDU is same as of workstation for SCADA/DMS system mentioned above, except, it shall have suitable software & hardware to facilitate remote VDU user to monitor remotely , the real time power system from SCADA/DMS system & have facility to generate report. The additional associated hardware is mentioned in the BOQ.

1.12. TFT colour monitor

The TFT monitor shall have flat panel colour screen. The following is the minimum characteristics of TFT colour monitors

S. No	Specification	For 24”monitor
1	Diagonal Viewable size	24”
2	Viewing angle	Sufficiently wide horizontal & vertical viewing angles
3	Dot Pitch	0.28 mm
4	Resolution	1280x1024 minimum
5	Colour support	16.7 million
6	Refresh rate	Minimum 75Hz
7	On screen control	Yes
8	Anti glare & anti static	Yes
9	Tilt , Swivel	Yes

1.13. WAN router

The minimum specifications are provided below. It is expected that the bidder shall analyze the performance requirement and adopt the latest standards and memory/server capacity.

Wan router shall be required for data exchange of SCADA /DMS control centres with DR centre, their respective IT system (IT Data centre, ITDR centre), and remote VDUs and LDMS & SLDC optional. The data exchange between the two centres shall be over TCP/IP using Ethernet based communication network on various mediums viz FO, radio etc. The router shall have the following features:

a. support the OSI and TCP/IP protocols
b. support X.21/V.35/G.703 interface for interfacing communication links or similar latest protocols

WAN Routers shall be required for data exchange of SCADA/DMS-OMS control centres with RTUs at various locations in the respective town, SCADA/DMS DR centre, LDMS & SLDC ,UTILITY's respective IT system (Data centre, DR centre, customer care centre, UTILITY's Head Quarter and various other offices), remote VDUs etc. The data exchange between the two centres shall be primarily over MPLS based secured network using TCP/IP on various mediums as per the requirement and availability in the respective project area viz FO, radio, V-SAT etc. The router shall support the OSI and TCP/IP protocols.

The Routers shall be compatible with Owners existing MPLS based Wide Area Network created/ to be created IT infrastructure. The Wide Area Links are planned for 2Mbps or higher Bandwidth capacity (10/100/1000Mbps) from ISPs (BSNL, MTNL or any other ISP). The Router offered shall deliver high performance IP/MPLS features and shall support Layer 3 MPLS VPN connection. It shall support PPP/Frame Relay transport over MPLS. The Routers shall be configurable and manageable through local console port, http interface, NMS software and as well through Telnet. The Router shall provide built-in monitoring and diagnostics to detect failure of hardware. The Router shall be provided with LED/LCD indication for monitoring the Operational status.

The configuration changes on the Router should take effect without rebooting the router or modules.

a. <u>Memory</u>

i. Flash: Minimum 8MB and upgradable upto 72MB
ii. SDRAM: Minimum 64MB and upgradable upto 320MB

b. Console Port: 01 No. for configurations and diagnostic tests.

c. LAN/WAN Port: The router shall support variety of interfaces as per the concerned UTILITY's requirement at site like V.24, V.35, E1, Channelized E1 etc. along with following minimum number of ports :

i. Two fixed 10/100M high speed Ethernet ports
ii. Two fixed Serial ports with synchronous speed up to 2 Mbps and with interface support for V.35, V.24 ports
iii. Two fixed ports of G.703 E1 (2 Mbps) interface
iv. One AUX port
v. Total no of ports shall be determined by the connectivity requirement.
vi. The entire interface cables for interconnecting all LAN/WAN ports as well as connection to SCPC/MCPC/ leased E1 – V.35 ports etc. shall be in the scope of bidder.

d. Scalability: Should have provision of atleast 100% additional number of free ports for future scalability

e. Network Protocol: TCP/IP and support for IP version 6 . Shall provide IP address Management.

f. Routing Protocols: RIP v1 (RFC 1058), RIPv2 (RFC 1722 AND 1723), OSPFv2 (RFC1583 & RFC 2328), OSPF on demand (RFC 1793), BGP4 with CIDR implementation as per RFC 1771. The implement should be compliant as per RFC1745 that describes BGP4/IDRP IP OSPF interaction. It shall provide Policy routing to enable changes to normal routing based on characteristics of Network traffic. IS-IS protocol support (RFC 1195).

g. WAN Protocols: Frame Relay (LMI & Annex.D & ITU Annex A), PPP (RFC1661), Multi-link PPP (RFC1717), HDLC/LAPB, Frame Relay support shall include Multi-protocol encapsulation over Frame relay based on RFC1490, RFC 1293 for Inverse ARP/IP, DE bit support.

h. High Availability: Shall support redundant connection to LAN For high availability, the router should support the standards based RFC 2338 Virtual Router redundancy Protocol (VRRP) or equivalent.

i. Network Management: SNMP, SNMPv2 support with MIB-II and SNMP v3 with Security authentication. Implementation control configuration on the Router to ensure SNMP access only to SNMP Manager or the NMS work Station.

j. RMON 1 & 2 support using service modules for Events, Alarms, History.

i. Should have accounting facility.
ii. Shall support multilevel access.
iii. Shall be Manageable from any Open NMS platform.
iv. Shall support for telnet, ftp, tftp and http & https enabled Management.
v. Should have debugging facility through console.

k. AAA Authentication support shall be provided via RADIUS (Remote Authentication Dial-IN User Service) and/or TACACS, PAP/CHAP authentication for P-to-P links, 3DES/IPSec encryption with hardware based encryption services.

l. Optimization feature:

i. Data Compression for both header and payload to be supported for Frame Relay and Leased/Dial-up WAN Links. Dial restoral on lease link failure Dial on demand or congestion, Load Balancing.
ii. Support for S/W downloads and quick boot from onboard Flash. Online software re-configuration to implement changes without rebooting. Should support Network Time Protocol for easy and fast synchronization of all Routers.

m. QOS Support:

i. RSVP (Resource Reservation Protocol as per RFC 2205), IGMP v1, v2 (Intergroup Management Protocol Version 2 as per RFC 2236), Multicast Routing support like PIM-SM (RFC 2362), PIM-DM etc.,
ii. Policy based routing (It shall be possible to affect the normal routing process for specific mission critical traffic through specified alternate routes in the network).
iii. A class based scheduling, Priority Queuing mechanism that shall provide configurable minimum Bandwidth allocation to each class and IP Precedence.
iv. Congestion Avoidance – Random Early Detection (RED). Support for Differentiated Services as per RFCs 2474, 2475, 2598 & 2597.

n. Switching Performance: 200 Kpps or higher as per UTILITY requirement at site
o. The following routers will be required as minimum. The minimum port requirement is specified above. However, bidder shall determine no. of ports requirement on the basis the interface & performance, availability & functional requirements & shall provide additional features/ ports over and above minimum requirement specified:
i. SCADA/DMS-OMS router
ii. Intranet router at/DMZ
iii. DR router
iv. Router at S/S & remote VDUs locations
p. Local Area Network (LAN) and Device Interfaces: Servers, consoles and 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. Four LAN shall be formed namely SCADA/DMS, DTS, developmental system & DMZ. Dual LAN is envisaged each for the SCADA /DMS system & DMZ system & Single LAN is envisaged each for DTS & development system. At DR centre also redundant LAN is envisaged. LAN shall have the following characteristics:
i. Shall conform to the ISO 8802 or IEEE 802 series standards.
ii. Shall preclude LAN failure if a server, device, or their LAN interface fails.
iii. Shall allow reconfiguration of the LAN and the attached devices without disrupting operations
iv. Shall be either controlled LAN such as Token passing or uncontrolled LAN such as CSMA/CD
v. Shall have minimum of twenty four (48) ports of 10/100/1000Mbps per LAN switch for SCADA/DMS LAN & (24) ports be considered for DMZ system, DTS & development system & DR system each,)

1.14. Printers:

a. Except for the output capabilities unique to any printer type (such as extended character sets, graphic print and colouring features), there shall be no limitations on the use of any printer to perform the functions of any other printer. All the SCADA/DMS system printers except Logger shall have dual LAN interface either directly or through internal/external print servers. Printers for DTS & development system shall have single LAN interface. The characteristics for each type of printer are described below:
b. Colour inkjet printer: Colour inkjet printer shall be used to take colored hardcopy printout. The Printer shall have the following features:
i. Shall be suitable for printing on A4 & A3 size normal paper.
ii. The printout shall match to object/content to be printed in colour & size.
iii. Shall have resolution of at least 1200 X 1200 dots per inch.
iv. Print time shall be less than 60 seconds per page for a coloured printout in normal mode for A4 size of printing.
v. Shall have suitable port for connectivity with Remote VDU.
vi. shall have input & output trays
vii. shall have landscape and portrait print orientation

c. Black & White Laser Printer : It is a multipurpose printer used to take prints of displays, reports etc. The laser printer shall have the following features:
   i. shall be black & white laser printer
   ii. have speed of at least 17 pages per minute
   iii. Minimum resolution of 1200 dots per inch
   iv. Landscape and portrait output orientation
   v. Memory buffer of at least 48 Mbyte
   vi. Shall be suitable for A4 size normal paper
d. Colour Laser Printer: It is a multipurpose printer used to take prints of displays, reports etc. The colour laser printer shall have the following features:
   i. shall be colour laser printer
   ii. have speed of at least 10 pages per minute for A3 & 17 pages for A4 in color
   iii. 600 X 600 dpi
   iv. Landscape and portrait output orientation
   v. Duplex printing
   vi. Memory buffer of at least 128 Mbyte

1.15. Time and Frequency system

GPS based time facility, using Universal Time Coordination (UTC) source, shall be provided for time synchronization of computer system at SCADA/DMS control centre. The time receiver shall include an offset adjustment to get the local time. It shall have propagation delay compensation to provide an overall accuracy of +1.5microsec. The GPS system shall have dual 10/100/1000Mbps LAN interface. The GPS receiver shall be provided in redundant configuration

The time receiver shall detect the loss of signal from the UTC source, which shall be suitably indicated. Upon loss of signal, the time facility shall revert to its internal time base. The internal time base shall have a stability of 2ppm or better.

The GPS system shall include digital displays for time and date in the format DDD: HH:MM:SS (the hour display shall be in 00 to 23 hour format)

GPS system shall also be used to drive separate time , day & date indicators which shall be wall mounted type. The display for time shall be in the 24-hour, HH:MM:SS format. The display for the day & date shall be xxx format (MON through SUN) & DD: MM: YYYY respectively. .

Contractor shall provide wall mounted type digital display units for time, day, date & frequency indication. The display of frequency shall be in the xx.xx Hz format. The frequency shall be derived from 230V AC supply.

Each digit on the time, day and frequency indicators shall be at least 7.5 cm in height and shall be bright enough for adequate visibility in the control room from a distance of 15 meters.

The offered GPS clock shall also provide at least one 2 MHz (75 ohm interface confirming to ITU-T G.703) synchronization interface to meet the time synchronization requirement of the communication system This interface shall confirm to the requirements specified in ITU-T G.811 for accuracy, jitter, wander etc. Alternatively, a separate GPS clock for synchronization of communication system is also acceptable.

1.16. External Cartridge Magnetic tape drive

One external 4mm DAT,160/320 GB Cartridge magnetic tape drive shall be supplied for taking Backups and performing restores of the Hard disks of any computer. The external tape drive shall have hot-

pluggable port for connection to any computer. Bidder may also provide equivalent Magneto Optical (MO) –disk in place for DAT drive (Cartridge magnetic tape drive)

1.17. Digital Light Processing (DLP) based Video Projection System

The contractor shall provide a video projection system based on modular DLP (Digital Light Processing) technology. All the screen modules of the VPS system, shall be suitable to form combined high resolution projection images. The VPS system will be used to project displays of SCADA/DMS-OMS system independently of workstation console monitors. All the operations envisaged from workstation console (dispatcher) shall be possible from VPS also.

The Contractor shall supply all necessary hardware and software, including the multi-screen drivers, adapters and memory to seamlessly integrate the video projection system with the user interface requirements described in the specification.

The video projection systems shall be rear projection systems 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 system includes:

a. VPS screen with 2x3 matrix with each module minimum 67" diagonal or 80 inch industrial grade full HD monitor
b. VPS screen shall form a seamless rectangular array, using modules. (0.5mm) max
c. VPS Graphics controller shall be interfaced to the SCADA/DMS-OMS system through dual LAN connectivity.
d. Each projector shall provide a minimum resolution of 1024X768 pixels per module. The rear projection screens shall be capable of displaying full resolution of the source.
e. The VPS shall be capable of supporting multiple display modes in which one or more modules show one or more SCADA/DMS-OMS displays concurrently as selected by the user.
f. This system shall provide the same functional display capability as the full graphics workstations.
g. The VPS shall have a horizontal & vertical viewing angle of approximately 160 degrees. The half gain angle shall be at least 40 degrees with a tolerance of + 5 degrees for both horizontal & vertical directions.
h. The overall brightness of individual projector shall be at least 550 ANSI lumens. The luminance measured at the screen shall be minimum 100 candelas/sqm.
i. The projection bulb (lamp) shall have an average operating life of 9,000 hours (typical).
j. Centre to corner brightness shall be generally uniform.
k. The configuration of the VPS (no. of screens and size of each screen) is defined in the BOQ.
l. The VPS controller shall have audio-video signal input module to interface with video conferencing equipment, CCTV, VCD/DVD players. The VPS controller shall support three types of video signal inputs (PAL, SECAM. NTSC).

1.18. Furniture

UTILITY shall provide necessary furniture & shall look aesthetically pleasing. It is not in the scope of contractor.

1.19. Auxiliary Power Supply for Computer systems

The computer system should be suitable for operation with single-phase, 230 +10% Vac, 50 +5.0% Hz power supply. To ensure uninterrupted & regulated power supply to computer system, suitable rating UPS are envisaged under auxiliary power supply specification. All cables supply, laying & their termination between UPS panel & computer system shall be in the scope of contractor. The input circuit

breakers are provided in the UPS for protection against short circuits, any additional fuses, switches and surge protection if necessary to protect the hardware shall also be supplied by the Contractor. The auxiliary power to all computer system hardware shall be fed from parallel operating UPS system. On interruption of input AC power to UPS, the load shall be fed through UPS inverter through it's batteries. In case of battery capacity low conditions (due to prolonged failure of input supply to UPS), the computer system shall go for orderly shutdown to avoid corruption of any applications. The orderly shutdown of computer system can be implemented either through RTU (where UPS alarms shall be wired to RTU) or through suitable interface with UPS Supplier software.

1.20. Environmental Conditions

Equipment to be located in the SCADA/DMS control centre building shall operate over an ambient temperature range of 16□C to 32□C, with a maximum rate of change of 5□C per hour. Relative humidity will be less than 80% non-condensing..

1.21. Acoustic Noise Level

The noise level of any equipment located in the control room shall not exceed 60dbA measured at three feet from equipment especially for the printers.

1.22. Construction Requirements of panels

In case the equipments are mounted in panel type of enclosures, then such enclosures shall meet the following requirements:

a. Shall be free-standing, floor mounted and shall not exceed 2200 mm in height.
b. Enclosures shall be floor mounted with front and rear access to hardware and wiring through lockable doors.
c. 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.
d. The safety ground shall be isolated from the signal ground and shall be connected to the ground network Each ground shall be a copper bus bar. The grounding of the panels to the owner's grounding network shall be done by the contractor.
e. All enclosures shall be provided with, 230 VAC 15/5A duplex type power socket & switch for maintenance purpose.
f. All panels shall be provided with an internal maintenance lamp and space heaters, 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. Cooling air shall be drawn from the available air within the room. 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. Suitable sized terminal blocks shall be provided for all external cablings.

1.23. Assembly and Component Identification

Each assembly in the system, to the level of printed circuit cards, shall be clearly marked with the manufacturer's part number, serial number, and the revision level. Changes to assemblies shall be indicated by an unambiguous change to the marked revision level. All printed circuit card cages and all slots within the cages shall be clearly labelled. Printed circuit cards shall be keyed for proper insertion orientation.

1.24. Interconnections

All signal cabling between component units of the computer systems shall be supplied by the Contractor. Plug-type connectors shall be used for all signal interconnections. The connectors shall be polarized to prevent improper assembly. Each end 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 enclosures.

1.25. Consumables

The Contractor/SGIA shall supply, at its own expense, all consumables required for use during all phases of the project through completion of the system availability test. The consumable items shall include as minimum :

(a) Magnetic cartridges (DAT)/ MOdisks
(b) aPrinter paper
(c) Printer toner, ink. Ribbons and cartridges
(d) bSpecial cleaning materials
(e) CDs/DVDs/USB thumbdrives

Certain criteria for Hardware /Configuration

One operator workstation shall be considered per 10 S/S at SCADA/DMS control centres. However, for locations less than 20 S/S shall have 2 operator workstation as minimum.

Remote VDUs shall be required at one each at HQ , Division, IT office & LDMS at S/S

Refer section 1 chapter 1 for configuration for the hardware configuration of the SCADA/DMS system.

2. SYSTEM SOFTWARE REQUIREMENTS

2.1. General

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) to be provided by Contractor and the original software manufacturer as necessary to support the SCADA/DMS-OMS applications. This section also describes the standards to be followed for all supplied software. The contractor shall make use of common applications such as security, networking etc created under IT infrastructure. However, it is necessary that functional, availability & performance aspects are met. Bidder shall assess the adequacy of software specified & if any additional software is required to meet all the requirements of the technical specifications, the same shall also be included in the offer.

2.2. Software Standards

All SCADA/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, IEEE, ECMA in order to facilitate maintenance and enhancement of the SCADA/DMS systems being supplied. In areas where these organizations have not yet set standards, the software shall comply with those widely accepted de- facto standards put forth by industry consortiums, such as OSF and X/Open. The Contractor shall commit to meet the "open systems" objective promoted by industry standards groups by using software products that are based on open standards

2.3. 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

2.4. Operating System

The contractor shall use Unix /Linux / Microsoft Windows™ operating system servers. The servers based on of Unix O/s, shall generally comply with the evolving set of POSIX standards defined by IEEE. The SGIA shall be based on a wide-spread operating system with native 64-bit architecture that complies with key

standards POSIX 1003.1, 1003.1b, 1003.1c, 1003.2, X/Open XPG4/XPG4.2, and X/Open Federated Naming. Linux is preferred.

2.5. Time and Calendar Maintenance

The SCADA/DMS-OMS system shall maintain Time and date for use by various software applications. The GPS based time receiver shall be used for synchronising the SCADA/DMS-OMS system time. All Servers and Operator workstation clocks shall be synchronised within the accuracy of +/-100 milliseconds. The SCADA/DMS-OMS system shall not be dependent on a particular server for time /calendar maintenance. The SCADA/DMS-OMS 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-OMS 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.

2.6. Network Software

The network software for SCADA/DMS system shall include software for network communication, security and services.

2.7. Network Communication

Users and various applications shall be able to communicate within the SCADA/DMS local area network and operate as described in this Specification. The network communications software shall use a standard network protocol such as TCP/IP. The software shall link dissimilar hardware nodes, including local and remote workstations, application servers, communication servers, and various peripherals (such as printers) into a common data communication network allowing communications among these devices.

2.8. Network Security

A user authentication scheme consisting at least of a user identification and password shall be required for the user to request a connection to any network node.

2.9. Network services

The following network services shall be provided for the users of SCADA/DMS system:

a. Network file management and transfer, for files containing text, data, and/or graphics information
b. Network printing management
c. Network time synchronization
d. Network backup over LAN
e. Task-to-task communications to external computers
f. LAN global naming facilities.
g. Remote procedure call

h. Remote terminal session

2.10. Security Services

The security solution shall comprise of comprehensive solution for secured zone Firewalls i.e LAN Firewall & Gateway Firewall, intrusion Prevention system IPS (Network based & Host based) & Strong Authentication (multi layered), LDAP , Encryption mechanism. The contractor/SGIA shall provide a tightly integrated intrusion detection system to detect and prevent intrusion

Followings are the functional requirement from the security system:

a. System shall have Multilayer (at least network, application layer) firewall which shall protect the complete system network from unwanted users. Further the separate firewall of different OEMs shall be provided to take care the security of all the servers & shall have High Availability architecture with No Single Point of Failure (NSPOF).
b. Gateway Firewall should be capable of load balancing multiple links from different service providers.
c. LAN Firewall shall provide isolation/security services between the subsystems installed under SCADA system
d. Firewalls deployed should not become a bottleneck. It shall be Robust, Secure, Scalable and future-proof with Centralized Management.
e. Two type of IPS Host based & Network based shall be deployed with minimum hardware & they should not go blind in peak traffics.
f. IPS should have hybrid technology to detect attacks. It should detect through a combination of Protocol Anomaly and Signature matching.
g. Shall have Gateway antivirus which will protect from inflow of virus from the Internet and other WAN locations at the gateway itself with content filtering without any lag in data transmission.
h. Shall have strong authentication containing user name and passwords which shall be very difficult to compromise.
i. SSL over VPN to provide secured link over public network such as with RTU/FRTU/FPI

The SGIA shall provide the best solution for security services and protection of the SCADA/DMS-OMS. This includes the above mentioned points as well as any other as the SGIA sees applicable.

2.11. Features

Followings are the features specific to each component of security system

a. Firewall

The Firewall shall be hardware box Firewall system with following features.

i. Firewall speed >250 Mbps
ii. Data encryption supported DES (56 bits) 3 DES (168 bits) and hashing algorithm like MD5 and SHA-1
iii. Encryption to offload the main CPU
iv. It shall have minimum 8 Ethernet 10/100 /1000 ports (4ports for connectivity to two web servers & 4 Ports for connectivity to LAN
v. Support NAT and PAT
vi. Capability of working in Load sharing and hot standby mode
vii. Denial of service prevention.
viii. DNS guard features

ix. JAVA and ActiveX blocking
x. Radius integration
xi. Web based management interface
xii. Stateful inspection for web, mail, SQL application etc.
xiii. Detailed system logging and accounting feature
xiv. No. of concurrent TCP Sessions supported shall be more than 5000.

b. Intrusion Prevention System (IPS)

The contractor shall provide a tightly integrated intrusion detection & prevention system Capable for detecting the intrusion attempt that may take place and intrusion in progress and any that has taken place.

Both Network based and Host based IPS should have centralized Management Console system which will be either the application server with NMS or any of the workstation. The Centralized management console shall have integrated event database & reporting system & it must be able to create and deploy new policies, collect and archive audit log for post event analysis. The system shall have Integrated Event Database & Reporting System. Automated Update of the signature for two years shall be provided and there should be provision for creating customized signature

i. Intrusion Prevention System (Network Based)

After detecting any intrusion attempt there should be provision to configure to perform the following functions:

- Capability for Detecting the intrusion attempt that may take place, intrusion in progress and the intrusion that has taken place
- Reconfigure the firewall provided in this package.
- Beep or play a .WAV file (audible alert)
- Send an SNMP Trap datagram to the management console. The NMS serve envisaged under the specification shall be used as management console also.
- 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).
- Save a trace file of the raw packets for later analysis
- Launch a separate program to handle the event
- Forge a TCP FIN packet to force a connection to terminate.
- Detect multiple forms of illicit network activity: -Attempted
- Vulnerability Exploits -Worms -Trojans -Network Scans -Malformed Traffic -Login Activity

The System shall support monitoring of multiple networks. The system shall also support the monitoring of additions or changes to addresses of devices on the network.

The system shall have detection rules for monitoring faults, dangerous and malicious activity related to IP based protocols. The Contractor shall also apply its power control and security experience to enhance these detection rules for specific issues within the system.

ii. Intrusion Prevention System (Host Based)

Host based IPS shall run on the servers. After detecting any intrusion attempt there shall be provision to configure the IPS to perform following actions

- Send an SNMP Trap datagram to the management console. The NMS server envisaged under the specification shall be used as management console also.
- Send an event to the event log. Send e-mail to an administrator to notify of the attack.
- It should be capable of creating 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 unauthorized attempt to overwrite vital system files, to install Trojan horses or backdoors, suitable action shall be taken such as :
  - Terminate user Login (intruder)
  - Disable user Account (intruder)
  - Administrator can define the action to be taken
  - Forge a TCP FIN Packet to force an intruder connection to terminate.
- Should provided events check for suspicious file transfers, denied login attempts, physical messages (like an Ethernet interface set to promiscuous mode) and system reboots.

2.12. 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:

a. It shall have Policy-based URL filtering and Dynamic Document Review.
b. It shall protect web traffic with high-performance, integrated virus scanning and web content filtering at the gateway
c. It shall ensure protection by combining list-based prevention with heuristic content analysis for both virus protection and web content filtering
d. 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.

2.13. 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:

a. Application Software Error Conditions
b. Application Software Performance Issues
c. Application Configuration Changes
d. Application Logins, etc.

2.14. 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:

a. Instant notification through email or pager
b. Logical grouping of security events by time, location, and device, etc
c. Interactive dashboard window for viewing and acknowledgement

2.15. 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 be capable of creating new custom analysis and reports, and revising existing, without requiring external consultation.

2.16. 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.

2.17. 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 atleast 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-OMS protected LAN.
c. Internal SCADA/DMS-OMS users shall not have any dependency on the availability of the Web servers.
d. For the purpose of transfer of data/displays/ from the SCADA/DMS-OMS system to the Web server system, the SCADA/DMS-OMS 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-OMS system LAN. Interface between Web server and SCADA/DMS-OMS zone shall preclude the possibility of external clients defining new data/Report/Displays.
e. For any sessions initiating from the DMZ LAN into the protected LAN, the servers shall be located 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.

f. 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.
g. The Web server at Control Center shall also facilitate exchange of email messages from ISP (Internet Service Provider) and other mail servers supporting SMTP.
h. 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).
i. Typical displays/pages for Intranet access shall be same as that on the SCADA/DMS-DMS. Real time SCADA data on web server shall be refreshed every minute
j. 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, incharge 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.

2.18. 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.

2.19. Network Management system (NMS)

A network monitoring and administration tool shall be provided. The interface of this tool shall show the DMS hardware configuration in form of a map. The network-monitoring tool shall automatically discover the equipment to construct the map. It shall support management of multi-Vendor network hardware, printers, servers and workstations. It shall support remote administration of network devices, management of thresholds for monitoring performance and generation of alarm and event notifications. It shall be possible to send these notifications to maintenance personnel through e-mail. The network management system shall manage the interfaces to the SCADA/DMS-OMS servers, workstations, devices, communication interface equipment, and all SCADA/DMS-OMS gateways and routers ,switches etc. The network management software shall be based on the Simple Network Management Protocol (SNMP-Internet RFC 1157) over TCP/IP (CMOT), with additional proxy software extensions as needed to manage SCADA/DMS resources.

SCADA centric network monitoring tool shall be supplied to monitor the IT infrastructure such as servers/workstations, CPUs, memory usage, etc inside the control center using SNMPv3. There shall be provision to configure network monitoring tool in SCADA dashboards and ability to build system maintenance display in SCADA display editing tool. This system architecture display shall be linked to real-time values obtained from the network monitoring tool through SNMP.

The NMS software shall provide the following network management capabilities:
a. Configuration management
b. Fault management
c. Performance monitoring.

The network management software shall:

a. Maintain performance, resource usage, and error statistics for all of the above interfaces (i.e. servers, workstation consoles, devices, telephone circuit interface equipment, and all SCADA/DMS-OMS gateways, routers etc) and present this information via displays, periodic reports, and on-demand reports.
b. The above information shall be collected and stored at user configurable periodicities i.e. Upto 60 minutes. The Network Management System (NMS) shall be capable of storing the above data for a period of one year at periodicity of 5 minutes.
c. Maintain a graphical display of network connectivity to the remote end routers
d. Maintain a graphical display for connectivity and status of servers and peripheral devices for local area network.
e. Issue alarms when error conditions or resource usage problems occur.
f. Provide facilities to add and delete addresses and links, control data blocks, and set data transmission and reception parameters.
g. Provide facilities for path and routing control and queue space control.

2.20. Database structure

The SCADA/DMS-OMS 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-OMS 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-OMS 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.

2.21. Software Maintenance and Development Tools

a. 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:

i. Program and data editing
ii. Program compiling and assembling
iii. Linking
iv. Loading, executing and debugging program.
v. Version management
vi. Concurrent development

The following features shall be provided:

i. Library management
ii. Programs allowing to copy and print any data or program files
iii. Backup and restore
iv. File comparison
v. Sort and merge
vi. Programs that allow to partially save and recover volumes
vii. Core and memory dump.

In addition tools shall have the following:

b. 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.

c. 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.

d. 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:

i. Program execution breakpoint control .
ii. Program execution sequence tracing
iii. Display and modification of program variables
iv. Attachment of specifically written debug code to the program under test.

The debugger shall allow halting execution of a program at predefined points, reading and modifying the registers and memory locations and executing step by step a program. Tender shall describe the features of debuggers for each type of equipment.

e. 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-OMS functions. The capability to restore the system to its status prior to the new program integration shall be provided.

f. 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-OMS. It shall not be necessary to return to the SGIA's facility or rely on the assistance of Contractor/SGIA personnel.

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.

g. Code Management

A code management UTILITY shall be provided for documenting and controlling revisions to all SCADA/DMS-OMS 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-OMS shall provide a software configuration management system to define the elements and the associated attributes of the applications provided in the SCADA/DMS-OMS. 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:

i. Manage source code and binary images
ii. Allow tracking of code changes by date, author, and purpose
iii. Manage documentation modules and associate them with source code, binary images, and other documentation
iv. Support multiple teams of programmers working concurrently on the same modules
v. Provide an efficient link between modules

h. Database Development software

The databases organization shall be designed to meet the following major functional requirements:

i. Data consistency
ii. Compliance with the system performance requirements including both response times
iii. expansion capabilities

A Database development software shall be provided which shall contain database structure definitions and all initialisation 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 initialise 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.

i. 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.
ii. Add, modify, and delete application program data
iii. Create a new database attribute or new database type
iv. Resize the entire database or a subset of the database
v. 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.

i. 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 in an effort to detect all errors present in the database before terminating the generation task.

j. 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.

k. Making Database Online

After an error-free database generation, the user shall be able to test the database 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-OMS server to ensure that all databases are consistent. Inconsistencies shall be enunciated to the user.

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-OMS 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-OMS system's reaction to hardware and software failures nor shall it require suspension of exchange of data among servers for backup purposes.

l. 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 atleast 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 atleast 2 months.

Initial Database Generation : The initial database shall contain all data required by the SCADA/DMS-OMS systems. Default values shall be used in consultation with the employer/Purchaser 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/Purchaser corporate Geographic Information System (GIS) as a part of any scheme 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 , landbase data etc . Further Land base data can be sourced from GIS in Shape files or DXF.

m. Display Generation and Management

SCADA/DMS-OMS displays shall be generated and edited using interactive 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:

i. Copy/move/delete/modify,

ii. Building at different zoom level,
iii. Linking of any defined graphics symbol to any database point,
iv. Pop-up menus,
v. Protection of any data field on any display against user entry based on log-on
vi. identifiers
vii. 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-OMS system shall be provided.

Displays shall be generated in an interactive mode. The user shall be able to interactively:

i. Develop display elements
ii. Link display elements to the database via symbolic point names
iii. Establish display element dynamics via database linkages
iv. Define linkages to other displays and programs
v. Combine elements and linkages into display layers
vi. Combine display layers into displays.

The display generation, compilation & loading shall not interfere with the on line SCADA/DMS-OMS functions. All user interface features defined in this Specification shall be supported by the display generator.

n. Display Elements

The elements available to create a display shall consist of graphic primitives symbols, segments, User Interaction Field and layers. These elements shall be available to be linked to the SCADA/DMS-OMS functions and dynamically transformed on the display as governed by linkages to the database.

o. 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, 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.

p. 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.

q. 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-OMS 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 or an existing display. 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 any display. To protect against loss of display work when computer fails, the current work shall be automatically saved every 5 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. A copy of previous display library shall be saved & protected and it shall be brought back on line or can be deleted upon user request.. 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.

r. 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.

s. Report Generation Software

The SCADA/DMS-OMS system shall include report generation software to generate new report formats for SCADA/DMS-OMS 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, or alphanumeric printer format. 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 of 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 shall not interfere in any server of the system with the on-line SCADA/DMS functions.

t. 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-OMS system. System build is the process under which all the above executables and the executables provided for SCADA/DMS-OMS application software are ported to the SCADA/DMS-OMS system hardware and configuring to make it operational.

The contractor/SGIA shall do the complete system generation and build as required for successful operation of the SCADA/DMS-OMS system. The contractor shall also provide the complete backup of the SCADA/DMS-OMS system in electronic media such as tapes, CDs, MO disks etc. Employer/Purchasers personnel shall be able to restore the SCADA/DMS-OMS 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 synchronised with the SCADA/DMS-OMS control centre.

u. Software Utilities

All software utilities used to maintain SCADA/DMS-OMS software, whether or not specifically required by this Specification, shall be delivered with the system.

The software utilities shall operate on-line (in background mode) without jeopardizing other SCADA/DMS-OMS application functions that are running concurrently. This UTILITY software shall be accessible from workstations, 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.

v. File Management Utility

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.

w. Auxiliary Memory Backup Utility

A utility to backup auxiliary memory of server and workstation files onto a user-selected auxiliary memory or archive device shall be supplied. The backup utility shall allow for user selection of the files to be saved based on:

i. Server and workstation
ii. File names (including directory and wildcard designations)
iii. File creation or modification date and time
iv. Whether or not the file was modified since the last backup.

A backup utility that can backup all server and workstation auxiliary memories on to a single target auxiliary memory or archive device shall be provided. The backup utility must ensure that the source auxiliary memory files are captured properly regardless of caching activity.

x. Failure Analysis Utility
Failure analysis Utility shall be provided to produce operating system and application program status data for analysing 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.

y. Diagnostic Utility
The system shall have suitable auto diagnostic feature, on line & offline diagnostic Utility for on-line and off-line monitoring for equipments of SCADA/DMS-OMS system shall be provided.

z. System utilisation Monitoring Utility
Software utility shall be provided in each server and workstation to monitor hardware and software resource utilisation continuously and gather statistics. The monitoring shall occur in real-time with a minimum of interference to the normal SCADA/DMS-OMS functions. 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.

aa. Other Utility Services
On line access to user and system manuals for all software/Hardware products (e.g., Operating System and Relational Database Software/hardware) and SCADA/DMS applications shall be provided with computer system.

3. TECHNICAL REQUIREMENTS OF RTU

3.1. General

The Remote Terminal Unit (RTU) shall be installed at primary substation to acquire data from Multifunction Transducers (MFTs), discrete transducers & status input devices such as CMRs etc. RTU & shall also be used for control of Substation devices from Master station(s). The supplied RTUs shall be interfaced with the substation equipment, communication equipment, power supply distribution boards; for which all the interface cables, TBs, wires, lugs, glands etc. shall be supplied, installed & terminated by the Contractor.

3.2. 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.

The RTU shall be designed around microprocessor technology. For easy maintenance the architecture shall support pluggable modules on backplane. The field wiring shall be terminated such that these are easily detachable from the I/O module.

3.3. RTU Functions

All functional capability described herein shall be provided by the Contractor even if a function is not initially implemented.

As a minimum, the RTU shall be capable of performing the following functions:

i. Acquiring analog values from Multifunction Transducers or alternatively through transducer- less modules and the status inputs of devices from the substation, processing and transmitting to Master stations. Capability to acquire analog inputs from analog input cards receiving standard signals viz current loops 4-20Ma standard signals such as 0-5vdc etc for RTD , transducer etc.
ii. Receiving and processing digital commands from the master station(s)
iii. Data transmission rates - 300 to 19200 bps for Serial ports for MODBUS. and 10/100 mbps for TCP/IP Ethernet ports
iv. IEC 60870-5-104protocol to communicate with the Master station(s), IEC 60870-5-101 for slave devices.& MODBUS protocol over RS485 interface, to communicate with the MFTs.
v. 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 stations.
vi. Remote database downloading of RTU from master station/SCADA/DMS control centre
vii. Act as data concentrator on IEC60870-5-101/104/MODBUS protocols
viii. Internal battery backup to hold data in SOE buffer memory & also maintaining the time & date.
ix. As the SCADA/DMS system will use public domain such GPRS/CDMA etc, therefore it mandatory to guard the data/ equipment from intrusion/damage/breach of security & shall have SSL/VPN based security.
x. Shall have SNMP

3.4. Support Feature:

All support feature as mentioned below will not be used now & may require in future. However, the same shall be tested in routine /Factory Tests. Further, it should be possible to have following

capabilities in the RTU by way of addition of required hardware limited to addition of I/O modules & communication card only & using the same firmware at later date:

i. Support for Analog output in form of standard current loops viz 4-20Ma etc
ii. Support for IEC 60870-5-103, IEC 61850 protocols & ability to act as a gateway for Numerical relays may have to be interfaced in future with numerical relays with future vision of Smart grid.
iii. Have required number of communication ports for simultaneous communication with Master station(s), /MFTs and RTU configuration & maintenance tool.
iv. PLC support
v. Communication with at least two master stations simultaneously on IEC 60870-5-104
vi. Receiving and processing analog commands from master station(s) and Capability of driving analog output card.
vii. RTU shall be capable of acquiring analog values through transducers having output as 4-20 mA, 0-10 mA, 0-+10 mA or +/- 5 volts etc using analog input modules.
viii. Capability of time synchronisation with GPS receiver which may be required future at the time of SMART GRID.

3.5. Communication ports

The RTUs shall have following communication ports to communicate with master station, existing /MFTs and configuration & maintenance terminal.

a. RTU shall have two TCP/IP Ethernet ports for communication with Master station(s) using IEC 60870-5-104.
b. RTU shall have required number of RS 485 ports for communication with MFTs to be connected in daisy chain using MODBUS protocol. Minimum 15 analog values (including 4 energy values) to be considered per energy meter The RTU shall be designed to connect maximum 5 MFTs. Further, bidder to demonstrate during testing that all analog values updated within 2 sec. The updation time shall be demonstrated during FAT(routine) & SAT testing . The bidder can offer MFT on IEC 60870-101/104 protocol to communicate with RTU.
c. In addition, if weather transducer & DC transducers are also having RS485 MODBUS port., the same can be also added in the daisy. However, total devices including MFT connected on one port shall not exceed.
d. RTU shall have one port for connecting the portable configuration and maintenance tool for RTU.
e. RTU as a data concentrator, then RTU shall have additional communication ports Ethernet or serial for IEC60870-5-104/101.
f. 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 support the use of a different communication data exchange rate (bits per second) and scanning cycle on each port & different database for each master station. FRTUs & FPIs shall be communicating to SCADA/DMS Master control using IEC60870-5-104 /101 protocol over GPRS/CDMA/Radio.

3.6. Master Station Communication Protocol

RTU shall use IEC 60870-5-104 communication protocol for communicating to master station. The RTU communication protocol shall be configured to report analog (except energy values) & status changes by exception to master stations. However, RTU shall support periodic reporting of analog data and periodicity shall be configurable from 2 sec to 1 hour. Digital status data shall have higher priority than the Analog data. The dead-band for reporting Analog value by exception shall be initially set to 1% (user

configurable) of the full-scale value. In addition, analog values shall also be reported to Master station by exception on violation of a defined threshold limit. All the analog values and status data shall also be assigned to scan groups for integrity check by Master stations at every 10 minutes configurable up to 60 minutes RTU wise.

RTU shall report energy values to master station periodically. The periodicity shall be configurable from 5 minutes to 24 hours (initially set for 15 minutes)

3.7. Communication Protocol between RTU & MFTs

The RTU shall acquire data from the MFTs using the MODBUS protocol. In addition, usage of IEC 60870-5-101/104 protocols is also permitted. The MFT will act as slave to the RTU. The RTU shall transmit these values to the master station in the frame of IEC 60870-5-104/101 protocol. As an alternate approach the UTILITY/contractor may use RTU as a data concentrator & acquire all the required analog data from DCU installed & connected to energy meters using MODBUS protocol under IT scheme. However, performance, functional, availability & update time requirement shall be met in this case also. It is the responsibility of UTILITY /contractor to assess this option & only opt in case it is found feasible,

3.8. Analog Inputs

The real time values like, Active power, Reactive Power, Apparent power three phase Current & Voltage and frequency, power factor & accumulated values of import /export energy values will be acquired RTU from the following in the given manner:

3.9. MFTs installed in substations

RTU shall also take 4-20 mA, 0-20mA, 0- -10mA, 0-+10mA, 0-5V etc as analog inputs to acquire transformer tap position, DC power supply voltage, weather transducer etc.

The RTU analog-to-digital (A/D) converters shall have a digital resolution of at least twelve (12) bits plus sign. The overall accuracy of the analog input system shall be at least ?0.2 %(i.e. 99.8%) at 25 ºC of full scale . Mean accuracy shall not drift more than 0.002% per degree C within the temperature range of –5 to +55 degree Linearity shall be better than ?0.05%. The RTU shall be designed to reject common mode voltages up to 150 Vac (50 Hz). For dc inputs, normal mode noise voltages up to 5 Vac shall be rejected while maintaining the specified accuracy.
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 upto 150% of the input value shall not sustain any failures to the RTU input.

The ability of the RTU to accommodate dc inputs shall include the following signal ranges:
Unipolar Voltage:0-0.5V, 0-1V, 0-5V, 0-10V,
Unipolar Current: 0-1mA, 0-10mA, 0-20mA, 4-20Ma,
Bipolar Voltage:0.5V, 2.5V, 5V, -20-0-20mA (- to +)

The total burden imposed by the RTU/DC analog input circuit shall not exceed 0.5 volt-ampere for current and voltage inputs. As an option, contractor may also provide transducer less solution to connect direct CT/PT secondaries.

3.10. Status input

RTU shall be capable of accepting isolated dry (potential free) contact status inputs. 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 48Vdc.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.

To take care of status contact chattering, a time period for each point and the allowable number of operations per time period shall be defined. If the allowable number of operations exceed within this time period, the status change shall not be accepted as valid

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.

The 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.

3.11. Sequence of Events (SOE) feature

To analyse the chronology or sequence of events occurring in the power system, time tagging of data is required which shall be achieved through SOE feature of RTU. The RTU shall have an internal clock with the stability of 10ppm or better . The RTU time shall be set from time synchronization messages received from master station using IEC 60870-5- 104 protocol. In addition, the message can be transmitted using NTP/SNTP. SOE time resolution shall be 1ms or better

The RTU shall maintain a clock and shall time-stamp the digital status data. Any digital status input data point in the RTU shall be assignable as an SOE point. Each time a SOE status indication point changes the state, the RTU shall time-tag the change and store in SOE buffer within the RTU. A minimum of 1000 events can be stored in the SOE buffer. SOE shall be transferred to Master Station as per IEC 60870-5-104 protocol. SOE buffer & time shall be maintained by RTU on power supply interruption.

3.12. IED pass through

The Master Station user shall be able to perform a virtual connection with any IED connected to the RTU/DC, provided the communication protocol functionality, to support the information transfer from and to the IEDs. For example, the Master Station shall gather on-demand IED data, visualize IED configuration parameters, and IED source code depending upon the IED capabilities. On the other hand, the Master Station shall be able to download to the IEDs configuration parameters, code changes, etc. depending upon the IED capabilities.

This feature is a support function considering in future SMART GRID implementation. The capability can be demonstrated with the upload & download of data from master station with IEDs connected to the RTUs using the support of protocols specified in this chapter. Numerical relays Analog data viz voltage ,current, sag swell instantaneous, momentary , temporary, over voltage, under voltage , over current , phasor measurement , THD, current TDD & current unbalance ratio etc at numerical relays if installed at bay of S/S

3.13. PLC capability

The RTU shall be provided with programmable logic capabilities supported by easy to use editor facilities. The programmable logic capability shall enable the RTU to perform control functions using ladder logic language conforming IEC 1131.

3.14. Control Outputs

The RTU shall provide the capability for a master station to select and change the state of digital output points. These control outputs shall be used to control power system devices such as Circuit breakers relay disable/enable and other two-state devices, which shall be supported by the RTU.

A set of control outputs shall be provided for each controllable device. On receipt of command from a master station using the select check-before-execute operate (SCBO) sequence, the appropriate control output shall be operated for a preset time period which is adjustable for each point from 0.1 to 2 seconds.

Each control output shall consist of one set of potential free NO contact. The output contacts shall be rated for atleast 0.2 Amp. at 48 Vdc. These output contact shall be used to drive heavy duty relays. In case Control output module of RTU does not provide potential free control output contact of this rating, then separate control output relays shall be provided by the contractor. These relay coils shall be shunted with diodes to suppress inductive transients associated with energizing and de-energizing of the relay coils & shall conform to the relevant IEC requirements.

3.15. Heavy duty control output relays

The control output contact from the RTU shall be used for initiating heavy duty relays for trip/close of switching devices and energising relays of OLTC raise lower. The contractor shall provide heavy duty relays. Each control output relays shall consist of atleast 2 NO contacts. The output contacts shall be rated for at least 5 Amps Continuous at 220Vdc 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 IEC255-1-00 and IEC 255-5 requirements.

3.16. Control Security and Safety Requirements

The RTU shall include the following security and safety features as a minimum for control outputs:

i. Select- check-before-operate operate (SCBO) sequence for control output.
ii. No more than one control point shall be select ed/executed at any given time.
iii. 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 period.
iv. No control command shall be generated during power up or power down of RTU.
v. 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 output s. 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.

3.17. Dummy breaker latching relay

The Contractor shall provide a latching relay to be used to simulate and test supervisory control from the Master station. The latching relay shall accept the control signals from the RTU to open and close, and shall provide the correct indication response through a single point status input.

3.18. Contact Multiplying Relays (CMRs)

Contact Multiplying Relays (CMRs) are required to multiply the contacts of breaker, isolators and protection relays etc. The contacts of these relays shall be used to provide status inputs to the RTUs.

The relays shall be DC operated, self reset type. The rated voltage for relay operation shall be on 24/48/110/220V DC depending on the station DC supply. The relay shall be able to operate for +/-20% variation from nominal voltage.

The relay shall have a minimum of two change over contacts, out of which one shall be used for telemetry purposes. The contacts shall be rated to carry minimum current capacity of 5A.

The relay shall conform to following requirement.

a. Power Frequency withstands voltage–2KV for 1 minute as per IEC 255-5.
b. Insulation Resistance of 100M ohms measured using 500V DC megger.
c. 5KV Impulse test as per IEC 255-5

The relays coils shall be shunted with diodes to suppress inductive transients associated with energizing and de-enegizing of the relay coils. The relays shall conform to the IEC 255-1-00 and IEC 255-5 requirements. The relays must be protected against the effects of humidity, corrosion & provide with a dust tight cover.

The connecting terminals shall be screw type & legibly marked. The relays may optionally have a visual operation indicator. The relays are to be mounted in Control & Relay (C&R) panels and therefore shall be equipped with suitable mounting arrangements. In case suitable space is not available in C&R panel the same shall be mounted in RTU panel or suitable panels, which shall be supplied & mounted on the top of the C&R panel by the contractor.

3.19. Time facility

The internal RTU time base shall have a stability of 10 ppm. The RTU shall be synchronised through synchronisation message from master station at every 15 minutes (configurable from 15 minutes to 24hrs) over IEC 60870-5-104/101/NTP/SNTP. The RTU shall also carry out time stamping of the events which are not received as time stamped from connected IEDs/ FPIs etc.

3.20. Diagnostic Software

Diagnostic Software shall be provided to continuously monitor operation of the RTU and report RTU hardware errors to the connected master stations. The software shall check for memory, processor, and input/output ports errors and failures of other functional areas defined in the specification of the RTU.

3.21. SCADA language based on IEC61131-3

RTU shall have capability to write various programs based IEC 61131-3 SCADA language. It will facilitate user to write various programs using points defined in the database.

3.22. Input DC Power Supply

The RTU will be powered from a 48 V DC power supply 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 Vdc with variation between 40.8 and 57.6 Vdc (i.e. 48(+20%/-15%)
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 mal-operation. The specification for DCPS is given in respective section of MTS.

3.23. 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 0 to +55 degree C with rate of temperature change of 20 degree C/hour and relative humidity less than 95%, non-condensing. For RTUs to be installed in the hilly region with the history of snowfall, the lower ambient temperature limit shall be -5 degree C.

3.24. RTU Size and Expandability

RTU shall be equipped for the point counts defined in the BOQ (Basic+20% spare (wired & hardware). It shall be possible to expand the RTU capability for additional 100 % of the basic point counts by way of addition of hardware such as modules, racks, panels; however, RTU software and database shall be sized to accommodate such growth without requiring software or database regeneration.

3.25. RTU Panels

At least 50% of the space inside each enclosure shall be unused (spare) space that shall be reserved for future use. The Contractor shall provide required panels conforming to IEC 529 for housing the RTU modules/racks, relays etc. and other required hardware. The panels shall meet the following requirements:

a. Shall be free-standing, floor mounted and height shall not exceed 2200 mm. All doors and removable panels shall be fitted with long life rubber beading. All non load bearing panels/doors shall be fabricated from minimum 1.6 mm thickness steel sheet and all load bearing panels, frames, top & bottom panels shall be fabricated from minimum 2.0 mm thickness steel sheet
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.

3.26. Wiring/Cabling requirements

The RTU panels shall gather all signals from and to the devices located in Control & Relay panels in the substation control room. All wires that carry low-level signals shall be adequately protected and separated as far as possible from power wiring. All wires shall be identified either by using ferrules or by

colour coding. In addition, cables shall be provided with cable numbers at both ends, attached to the cable itself at the floor plate where it enters the cubicles.

Shielded cables shall be used for external Cabling from the RTU panels. The 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 mm2 for PT cables, 4 mm2 for CT cables, if applicable and 2.5 mm2 for Control outputs and 1.5mm2 for Status inputs
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.
h. Armoured Cables shall be used in the area where cable will pass through open area which may experience loading.
i. The Communication cable shall be of shielded twisted pairs and of minimum 0.22sq mm size.

3.27. Terminal Blocks (TBs)

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. Required number of TBs shall be provided for 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. TBs 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.

3.28. RTU Architecture

Bidder has the option to offer RTUs having following architectural design:

a. Centralized RTU design where all I/O modules are housed in RTU panels and communicating with master station through communication port.
b. Distributed RTU design where distributed I/O modules/processor with I/O modules are housed in respective bay panels/RTU panel. All these distributed I/O modules / I/O modules with processor shall be connected to a central processor for further communication with master station. The bidder shall asses the requirement of RTU panels for such design and supply panels accordingly .
c. In both cases the RTU requirements as envisaged in this specification shall be followed.

3.29. LOCAL DATA MONITORING SYSTEM (LDMS)

The LDMS is a client workstation of main SCADA/ DMS control centre connected on 2Mbps or 64kbps leased line for local monitoring of SCADA/DMS system . The hardware & software specification, features shall be same as of remote VDU defined for SCADA/DMS system.

4. TECHNICAL REQUIREMENTS OF FRTU

4.1. General

The Feeder Remote Terminal Unit (FRTU) shall be installed at Ring Main Units (RMUs) , sectionalizer locations FRTU shall also be used for control of switching devices such as breaker, isolator switches etc inside RMU panel , sectionalizer etc from Master station(s). The supplied FRTUs shall be interfaced with the RMUs, FPI, communication equipment, power supply distribution boards; for which all the interface cables, TBs, wires, lugs, glands etc. shall be supplied, installed & terminated by the Contractor.

4.2. Design Standards

The FRTUs 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.

4.3. FRTU Functions

All functional capability described herein shall be provided by the Contractor even if a function is not initially implemented.

As a minimum, the FRTU shall be capable of performing the following functions:

a. Acquiring analog values from Multifunction Transducers or alternatively through transducer- less modules and the status inputs of devices from the substation, processing and transmitting to Master stations. Capability to acquire analog inputs from analog input cards receiving standard signals viz current loops 4-20Ma, RTD etc.
b. Receiving and processing digital commands from the master station(s).
c. Data transmission rates - 300 to 19200 bps for Serial ports for MODBUS. And 10/100 mbps for TCP/IP Ethernet ports. Use of IEC 60870-5-104/101 protocol to communicate with the Master station(s).
d. Use of MODBUS over RS485 interface, Protocol to communicate with the MFTs.
e. Have required number of communication ports for simultaneous communication with Master station(s), MFTs and FRTU configuration & maintenance tool.
f. FRTU 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 stations.
g. Remote database downloading of FRTU from master station from SCADA/DMS control centre.
h. Internal battery backup to hold data in SOE buffer memory & also maintaining the time & date.
i. As the SCADA/DMS system will use public domain such GPRS/CDMA etc, therefore it mandatory to guard the data/ equipment from intrusion/damage/breach of security & shall have SSL/VPN based security.
j. Shall support SNMP
k. Further it should be possible to have following capabilities in the FRTU by way of addition of required hardware limited to addition of I/O modules & communication card only & using the same firmware at later date:
l. Communication with at least two master stations simultaneously on IEC 60870-5-104 /101
m. RTU shall be capable of acquiring analog values through transducers having output as 4-20 mA, 0-10 mA, 0-+10 mA etc using analog input modules.

4.4. Communication ports

The RTUs shall have following communication ports to communicate with master station MFTs and configuration & maintenance terminal.

FRTU shall have one TCP/IP Ethernet port for communication with Master station(s) using IEC 60870-5-104/101 protocol or serial port in case IEC60870-101.

FRTU shall have required number of RS 485 ports for communication with MFTs/ to be connected in daisy chain using MODBUS protocol . Minimum 15 analog values (including 4 energy values) to be considered per energy meter. . The RTU shall be designed to connect maximum 5 MFT per port . Further , bidder to demonstrate during testing that all analog values updated within 2 sec . . The updation time shall be demonstrated during testing . 5.

FRTU shall have one port for connecting the portable configuration and maintenance tool for FRTU. SSL/VPN ,NERC/CIP complaint

It shall be possible to increase the number of communication ports in the FRTU by addition of cards, if required in future. The FRTU shall support the use of a different communication data exchange rate (bits per second) and scanning cycle on each port & different database for each master station.

4.5. Master Station Communication Protocol

FRTU shall use IEC 60870-5-104/101 communication protocol for communicating to master station. The FRTU communication protocol shall be configured to report analog (except energy values) & status changes by exception to master stations. However, FRTU shall support periodic reporting of analog data and periodicity shall be configurable from 2 sec to 1 hour.

Digital status data shall have higher priority than the Analog data. The dead-band for reporting Analog value by exception shall be initially set to 1% (in %) of the full scale value. In addition, analog values shall also be reported to Master station by exception on violation of a defined threshold limit. All the analog values and status data shall also be assigned to scan groups for integrity check by Master stations at every 10 minutes configurable up to 60 minutes FRTU wise.

FRTU shall report energy values to master station periodically. The periodicity shall be configurable from 5 minutes to 24 hours (initially set for 15 minutes)

4.6. Communication Protocol between FRTU & MFTs

The FRTU shall acquire data from the MFTs using the MODBUS protocol. In addition, usage of IEC 60870-5-101/104 protocols is also permitted. The MFT will act as slave to the FRTU. The FRTU shall transmit these values to the master station in the frame of IEC 60870-5-104/101 protocol.

4.7. Analog Inputs

The real time values like, Active power, Reactive Power, Apparent power three phase Current & Voltage and frequency, and power factor & accumulated values of import /export energy values will be acquired FRTU from the following in the given manner:

a. MFTs installed in RMU/DTs
b. RTU shall also take 4-20 mA, 0-20mA, 0- -10mA, 0-+10mA, 0-5V etc as analog inputs to acquire DC power supply voltage etc.
c. The FRTU analog-to-digital (A/D) converters shall have a digital resolution of at least twelve (12) bits plus sign. The overall accuracy of the analog input system shall be at least ?0.2 %(i.e. 99.8%) at 25 ºC of full scale . Mean accuracy shall not drift more than 0.002% per degree C within the temperature range of –5 to +55 degree Linearity shall be better than ?0.05%. The FRTU shall be designed to

reject common mode voltages up to 150 Vac (50 Hz). For dc inputs, normal mode noise voltages up to 5 Vac shall be rejected while maintaining the specified accuracy.

d. 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 upto 150% of the input value shall not sustain any failures to the FRTU input.
e. The ability of the FRTU to accommodate dc inputs shall include the following signal ranges:
   Unipolar Voltage:0-0.5V, 0-1V, 0-5V, 0-10V,
   Unipolar Current: 0-1mA, 0-10mA, 0-20mA, 4-20Ma,
   Bipolar Voltage: 0.5V, 2.5V, 5V, -20-0-20mA (- to +)
f. The total burden imposed by the FRTU analog input circuit shall not exceed 0.5 volt-ampere for current and voltage inputs. As an option, contractor may also provide transducer less solution to connect direct CT/PT secondaries.

4.8. Status input

RTU shall be capable of accepting isolated dry (potential free) contact status inputs. 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 Vdc/220VAC.

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.

To take care of status contact chattering, a time period for each point and the allowable number of operations per time period shall be defined. If the allowable number of operations exceed within this time period, the status change shall not be accepted as valid. 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.

The 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 FRTU from the field at 1 millisecond periodicity.

4.9. Sequence of Events (SOE) feature

To analyse the chronology or sequence of events occurring in the power system, time tagging of data is required which shall be achieved through SOE feature of RTU. The RTU shall have an internal clock with the stability of 100ppm or better . The RTU time shall be set from time synchronization messages received from master station using IEC 60870-5- 104 protocol. SOE time resolution shall be 10 ms or better

The RTU shall maintain a clock and shall time-stamp the digital status data. Any digital status input data point in the RTU shall be assignable as an SOE point. Each time a SOE status indication point changes the state, the RTU shall time-tag the change and store in SOE buffer within the RTU. A minimum of 300 events can be stored in the SOE buffer. SOE shall be transferred to Master Station as per IEC 60870-5-104 protocol. SOE buffer shall be maintained by FRTU on power supply interruption.

4.10. Control Outputs

The FRTU shall provide the capability for a master station to select and change the state of digital output points. These control outputs shall be used to control power system devices such as Circuit breakers, isolator, reset, relay disable/enable and other two-state devices, which shall be supported by the RTU.

A set of control outputs shall be provided for each controllable device. On receipt of command from a master station using the select check-before-execute operate (SCBO) sequence, the appropriate control output shall be operated for a preset time period which is adjustable for each point from 0.1 to 2 seconds.

Each control output shall consist of one set of potential free NO contact. The output contacts shall be rated for atleast 0.2 Amp. at 48 Vdc. These output contact shall be used to drive heavy duty relays. In case Control output module of FRTU does not provide potential free control output contact of this rating, then separate control output relays shall be provided by the contractor. These relay coils shall be shunted with diodes to suppress inductive transients associated with energizing and de-energizing of the relay coils & shall conform to the relevant IEC requirements.

4.11. Heavy duty control output relays

The control output contact from the FRTU shall be used for initiating heavy duty relays for trip/close of switching devices. The contractor shall provide heavy duty relays. Each control output relays shall consist of atleast 2 NO contacts. The output contacts shall be rated for at least 5 Amps Continuous at 220Vdc 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 IEC255-1-00 and IEC 255-5 requirements.

4.12. Control Security and Safety Requirements

The FRTU shall include the following security and safety features as a minimum for control outputs:

a. Select- check-before-operate operate (SCBO) sequence for control output.
b. No more than one control point shall be selected/executed 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 period.
d. No control command shall be generated during power up or power down of FRTU.

4.13. Local/Remote selector switch

A manual Local/Remote selector switch shall be provided for each FRTU to disable all control outputs by breaking the power supply connection to the control output s. When in the "Local" position, the Local/-Remote switch shall allow testing of all the control outputs of FRTU 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.

4.14. Dummy breaker latching relay

The Contractor shall provide a latching relay to be used to simulate and test supervisory control from the Master station. The latching relay shall accept the control signals from the FRTU to open and close, and shall provide the correct indication response through a single point status input.

4.15. Contact Multiplying Relays (CMRs)

Contact Multiplying Relays (CMRs) are required to multiply the contacts of breaker, isolators and protection relays etc. The contacts of these relays shall be used to provide status inputs to the RTUs. The relays shall be DC operated, self reset type. The rated voltage for relay operation shall be on 24/48/110/220V DC depending on the station DC supply. The relay shall be able to operate for +/-20% variation from nominal voltage. The relay shall have a minimum of two change over contacts, out of which one shall be used for telemetry purposes. The contacts shall be rated to carry minimum current capacity of 5A.

The relay shall conform to following requirement.

a. Power Frequency withstand voltage–2KV for 1 minute as per IEC 255-5.
b. Insulation Resistance of 100M ohms measured using 500V DC megger.
c. 5KV Impulse test as per IEC 255-5

The relays 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 255-1-00 and IEC 255-5 requirements. The relays must be protected against the effects of humidity, corrosion & provide with a dust tight cover. The connecting terminals shall be screw type & legibly marked. The relays may optionally have a visual operation indicator. The relays are to be mounted in junction /termination box and therefore shall be equipped with suitable mounting arrangements. In case suitable space is not available in junction /termination box the same shall be mounted in FRTU panel.

4.16. Time facility

The internal FRTU time base shall have a stability of 100 ppm. The RTU shall be synchronised through synchronisation message from master station at every 5 minutes (configurable from 5 minutes to 60 minutes) over IEC 60870-5-104/101/NTP/SNTP

4.17. Diagnostic Software

Diagnostic Software shall be provided to continuously monitor operation of the FRTU and report RTU hardware errors to the connected master stations. The software shall check for memory, processor, and input/output ports errors and failures of other functional areas defined in the specification of the RTU.

4.18. Input DC Power Supply

The FRTU will be powered from a 48 V DC power supply 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 Vdc with variation between 40.8 and 57.6 Vdc.(i.e. 48(+20%/-15%).
b. Maximum AC component of frequency equal to or greater than 100 Hz and 0.012 times the rated voltage peak-to-peak.

The FRTU 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 mal-operation.

4.19. Environmental Requirements

The FRTU will be installed in inside RMU Panel or in open environment with no temperature or humidity control.

The RTUs shall be capable of operating in ambient temperature from 0 to +55 degree C with rate of temperature change of 20 degree C/hour and relative humidity less than 95%, non-condensing. FRTUs to be installed in the hilly region with the history of snowfall, the same the lower ambient temperature limit shall be -5 degree C.

4.20. FRTU Size and Expandability

FRTU shall be equipped for the point counts defined in the BOQ (Basic+20% spare (wired & hardware). It shall be possible to expand the FRTU capability for additional 100 % of the basic point counts by way of addition of hardware such as modules, racks, panels, , however, FRTU software and database shall be sized to accommodate such growth without requiring software or database regeneration.

4.21. FRTU Panels

At least 50% of the space inside each enclosure shall be unused (spare) space that shall be reserved for future use. The Contractor shall provide required panels conforming to IEC 529 for housing the FRTU modules/racks, relays etc. and other required hardware. The panels shall meet the following requirements:

a. shall be pole/ wall mounted compact size cabinet. The size shall be preferably in the order of 400 mm. All doors and removable panels shall be fitted with long life rubber beading. All non load bearing panels/doors shall be fabricated from minimum 1.6 mm thickness steel sheet and all load bearing panels, frames, top & bottom panels shall be fabricated from minimum 2.0 mm thickness steel sheet
b. shall have maintenance access to the hardware and wiring through lockable 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 outdoor, dust-proof with rodent protection, and meet class of protection. IP41 if housed in RMU panel & IP54 in case of in open outdoor.
h. There shall be no sharp corners or edges. All edges shall be rounded to prevent injury.
i. 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.

4.22. Wiring/Cabling requirements

The FRTU panels shall gather all signals from and to the devices located in Control & Relay panels in the substation control room. All wires that carry low-level signals shall be adequately protected and separated as far as possible from power wiring. All wires shall be identified either by using ferrules or by colour coding. In addition, cables shall be provided with cable numbers at both ends, attached to the cable itself at the floor plate where it enters the cubicles.

Shielded cables shall be used for external Cabling from the FRTU panels. The 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 mm2 for PT cables, 4 mm2 for CT cables, if applicable and 2.5 mm2 for Control outputs and 1.5mm2 for Status inputs
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.
h. The Communication cable shall be of shielded twisted pairs and of minimum 0.22sq mm size.

4.23. Terminal Blocks (TBs)

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. Required number of TBs shall be provided for 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. TBs 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.

5. TEST EQUIPMENTS FOR RTU/FRTU

5.1. RTU/FRTU Configuration and Maintenance Tool

Test equipment for RTU/FRTU shall have Configuration and maintenance tool consisting of the followings:

5.2. RTU/ FRTU Data base configuration & Maintenance software tool

The RTU/FRTU database configuration & Maintenance software tool shall be required to perform the database modification, configuration, compilation and documentation. The database compiler shall provide error detection services. It shall also perform the downloading of the compiled database into the RTU database.

5.3. Master station-cum-RTU/FRTU simulator & protocol analyzer software tool

The Master station cum RTU/FRTU simulator tool shall be used to test the communication interfaces of Master station, RTU/FRTU and Electronic MFT. The Master station simulator tool shall be capable of emulating the master station for IEC 60870-5-104,101 and MODBUS protocols. The RTU/FRTU simulator shall be capable of emulating the slave protocols for both the IEC 60870-5-104,101, and MODBUS protocols for MFTs. It shall also be possible to prepare illegal messages for transmission, such as messages having invalid checksum.

The protocol analyser shall be used to monitor all communication traffic on a channel (between Master station & RTU/FRTU and between RTU/FRTU & MFT without interfering channels operation. Channel traffic captured in the active or passive modes of operation shall be displayed.

The Master station simulator and protocol analyser tool shall also have following features:

a. Each received message shall be checked for validity, including the check sum.
b. The tool shall maintain and display error counters so that the number of errors during a period of unattended testing can be determined.
c. All fields of a message shall be displayed. A pass/fail indication for the message shall be included.

5.4. Laptop PC for above software tools along with interfacing hardware

A laptop PC shall be used for the above mentioned software tools. The laptop PC shall be provided with all hardware accessories including cables, connectors etc. required for interfacing with Master station, RTU/FRTU and MFT. A suitable Hub shall be provided to use the tool in monitor mode. A carrying case and a suitable power adaptor (input 230VAC, 50Hz) for laptop PC shall also be supplied.

5.5. RTU/FRTU Testing

This chapter describes testing, training & documentation requirement for RTU/FRTU

a. Type Testing:

RTU/FRTU in including Transducers shall conform to the type tests listed in the relevant table. Type test reports of tests conducted in NABL accredited Labs or internationally accredited labs within last 5years 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. A complete integrated unit shall be tested to assure full compliance with the functional and technical requirements of the Specification including functional requirement. The testing sample shall include one of each type of cards/modules and devices. The list of Type tests to be performed on the RTU/FRTU is mentioned in Table-1 & type test requirements are mentioned in Table-2 of this chapter. For other items also such as MFT, sensor etc the requirements are mentioned in the respective sub sections of specification..

However, the type tests shall be only be limited to the specification of that item only & not as specified for RTU/FRTU.

b. Routine Testing or Factory acceptance test (FAT):

Each complete unit shall undergo routine testing. The list of Routine tests to be performed in the factory is mentioned in Table-2.

c. Site Acceptance Test (SAT)

(i) Field Tests

After RTU/FRTU panel installation , interface cabling with C&R panels/Termination boxes ,communication panel and interface cabling with field & communication equipment, the Contractor shall carry out the field-testing. The list of field tests for RTU/FRTU is mentioned in Table-2

(ii) Availability Tests

After field testing, RTU/FRTU shall exhibit a 98% availability during test period. Availability tests shall be performed along with Master station. The RTU/FRTU 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.

5.6. TRAINING

The contractor shall provide training to the Employer's personnel. The training program shall be comprehensive and provide for interdisciplinary training on hardware and software. The training program shall be conducted in English. RTU/FRTU training course shall cover the following:

a. RTU/FRTU operation including data flow.
b. Troubleshooting, identification and replacement of faulty Modules.
c. Preventive maintenance of the RTU/FRTU
d. Use of RTU/FRTU configuration and Maintenance tool
e. All functional and Diagnostic testing of RTU/FRTU
f. Database modification and configuration of RTU/FRTU

5.7. DOCUMENTATION

The Contractor shall submit 3 sets of all the standard and customised RTU/FRTU documents for review and approval which includes the following:

a. RTU/FRTU Function design document
b. RTU/FRTU Hardware description document & all the documents referred therein to meet all the clauses of the specification.
c. RTU/FRTU Test equipment user documents
d. RTU/FRTU user guide
e. RTU/FRTU Operation & Maintenance document
f. RTU/FRTU Training documentation
g. RTU/FRTU database document
h. RTU/FRTU I/O list
i. RTU/FRTU Test procedures
j. Data Requirement Sheet (DRS) of all items
k. Protocol documentation including implementation profile etc.
l. RTU/FRTU installation and Layout, GA, BOQ, schematics and internal wiring drawings for each RTU/FRTU site
m. RTU/FRTU to C&R panels/ field device cabling details for each RTU/FRTU site

After approval of all the above documents, the Contractor shall submit three sets as final documents. The site-specific drawings as indicated at item (i) and (j) above shall be submitted in three sets for each site before installation of RTU/FRTU. 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 of the RTU/FRTU.

Table-1: List of Tests on RTU/FRTU

Test Nos.	DESCRIPTION OF THE TEST	Type test	Routine test	Field test
A	FUNCTIONAL TESTS FOR RTU/FRTU			
	Check for BOQ, Technical details, Construction & Wiring as per RTU/FRTU drawings	√	√	√
	Check for database & configuration settings	√	√	√
	Check the operation of all Analog inputs, Status input & Control output points of RTU/FRTU	√	√	√
	Check operation of all communication ports of RTU/FRTU	√	√	√
	Check for communication with master stations including remote database downloading from master station	√		√
	Check for auto restoration of RTU/FRTU on DC power recovery after its failure	√		√
	Test for self diagnostic feature	√		√
	Test for time synchronization from Master	√		√
	Test for SOE feature	√		√
	End to end test (between RTU/FRTU & Master station) for all I/O points			√
	Test for MODBUS protocol implemented for acquiring data from MFT/ transducers and updation time demonstration in daisy chain configuration	√		√
	Test for IEC 60870-5 -104,101 protocol implemented	√		√
	Test for supporting other protocol	√		
	Test for operation with DC power supply voltage variation	√		
	Test for internal Clock stability	√		
	Test for Noise level measurement	√		
	Test for Control Security and Safety for Control outputs	√		
	Test for functionality/parameters verification of , CMRs & Heavy duty trip relays	√	√	√
	Test for data concentrator	√*		
	Test for IED pass through	√*		
	Test for SOE buffer & time data back up	√		
	Other functional tests as per technical specification requirements including features in	√		

Test Nos.	DESCRIPTION OF THE TEST	Type test	Routine test	Field test
	support/ capability (for future)			
	Test for DCPS of FRTU	√**		
	Test for compliance of standards for bought items viz. CMRs, Heavy duty trip relays , MFT,weather sensoretc	√		
	Test for functionality/parameters for bought items viz. CMRs, Heavy duty trip relays , MFT , weather sensor etc	√	√	
	Test for test tools		√	√
	Test for LDMS functioning		√**	√**
B	EMI/EMC IMMUNITY TESTS FOR RTU/FRTU			
	Surge Immunity Test as per IEC 60870-2-1	√		
	Electrical Fast Transient Burst Test as per IEC-60870-2-1	√		
	Damped Oscillatory Wave Test as per IEC 60870-2-1	√		
	Electrostatic Discharge test as per IEC 60870-2-1	√		
	Radiated Electromagnetic Field Test as per IEC 60870-2-1	√		
	Damped Oscillatory magnetic Field Test as per IEC-60870-2-1	√		
	Power Frequency magnetic Field Test as per IEC-60870-2-1	√		
C	INSULATION TEST FOR RTU/FRTU			
	Power frequency voltage withstand Test as per IEC 60870-2-1	√		
	1.2/50 µs Impulse voltage withstand Test as per IEC 60870-2-1	√		
	Insulation resistance test	√		
D	ENVIRONMENTAL TEST FOR RTU/FRTU			
	Dry heat test as per IEC60068-2-2	√		
	Damp heat test as per IEC60068-2-3	√		

Note: 1) Test levels for above type tests mentioned in B, C & D above are elaborated in Table 2 of this Chapter

* For RTU only & ** For FRTU only

Contractor can provide test certificates for the type tests mentioned in B,C,D & supporting protocols from Govt of India/NABL/International accredited Labs. If not provided, the same needs to conducted at Govt of India/NABL/International accredited Labs

Transducer type test requirements are mentioned in the respective sub section of specification.

Table—2 : RTU/FRTU Type Test Requirements

Test Nos.	Test Name	EUT Status	Test Level	Power Supply Points		I/O Points	Passing Criteria
				CM	DM	CM	

18	Surge Immunity Test	ON	Level 3	2 kV	1 kV	2 kV	A
19	Electrical Fast Transient Burst Test	ON	Level 3	2 KV	-	1 kV	A
20	Damped Oscillatory Wave Test	ON	Level 3	2.5 kV	1 kV	2.5 kV	A
21	Electrostatic Discharge Test	ON	Level 3	+/- 6 kV in Contact discharge mode or +/- 8 kV in Air discharge mode			A
22	Radiated Electromagnetic Field Test	ON	Level 3	10 V/m electric field strength			A
23	Damped Oscillatory Magnetic Field Test	ON	Level 3	30 A/m at 1MHz of magnetic field strength			A
24	Power frequency magnetic field	ON	Level 3	30 A/m of magnetic field strength (Continuous duration sine wave)			A
25	Power frequency voltage withstand	OFF	-	1 KVrms for 1 minute			No break down or flashover shall occur
26	1.2/50µs impulse voltage withstand	OFF	-	2 kVp			No break down or flashover shall occur
27	Insulation Resistance Test	OFF	-	Measure Insulation resistance using 500 V DC Megger before & after Power Freq & Impulse voltage withstand tests			As per manufacturer standard
28	Dry heat test	ON	-	Continuous operation at 550 C for 16 hrs			0
29	Damp heat test	ON	-	at 95% RH and 400 C			0

Note:-

EUT - Equipment Under Test

CM - Common Mode; DM - Differential mode

I/O pints do not include Communication ports

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

6. TRANSDUCERS & WEATHER SENSORS

6.1. Transducer & Weather Sensor Requirements:

All transducers including weather sensor shall use a 48 Vdc auxiliary power supply as provided for the RTU/FRTU. Optionally, MFTs can also be self powered. All transducers shall have a maximum power consumption of 10 watts. Transducer shall be din rail or wall/plate mounted.

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 to the following requirements, in addition to the requirement of IEC 60688, without damage to the transducer. Voltage:

Voltage test and other safety requirement compliance as specified in IEC 60688 or 607 and IEC 414.

a. Impulse Withstand: IEC 60688 or 60687 compliance is required.
b. Electromagnetic Compatibility: IEC 60688 or 60687 and IEC 801-3, level 1 compliance is required.
c. Permanent Overload Protection: IEC 60688 or 60687 compliance is required.
d. Temporary Overload Protection: IEC 60688 or 60687 compliance is required.
e. High Frequency Disturbance:IEC 60688 or 60687 compliance is required.

The transducers shall comply with the following general characteristics:

a. Shock Resistance: Minimum severity 50 A, IEC 68-2-27 requirements
b. Vibration Strength: Minimum severity 55/05, IEC 68-2-6 requirements.
c. Input Circuit Consumption: Less than or equal to 0.2 VA for voltage and 0.6VA for current circuits.
d. Reference Conditions For Accuracy Class: IEC 60688 or 60687compliance is required.
e. Temperature Rise: IEC 60688 or 60687 compliance is required.
f. (k) Operating Temperature: 0 o C to + 60 o C (-5 o C to + 55 o C for project area with snowfall history)

6.2. Multi Function Transducers (MFTs)

The contractor shall provide the multi function transducers for acquiring the real time analog inputs through 3 phase 3 wire CT/PTs circuits/ 3 phase 4 wire CT/PTs circuits (Based on the field requirement). Based on the CT/PT secondary rating , the multi function transducer shall be designed for nominal 110 V (Ph-Ph voltage) and 1A/5A (per phase current). The MFT shall be suitable for 20% continuous over load and shall be able to withstanding 20 times the normal current rating for a period one second. The MFT shall be able to accept the input voltages upto 120% of the nominal voltage. The MFT shall have low VA burden. MFTs shall be mounted in the interface cabinet to be supplied by the contractor.

Multi function transducers shall provide at least phase voltage, phase current active/reactive power , import & export energy (active & reactive) , pf , frequency with class 0.5 accuracy or better.

The parameters to be acquired from multifunction transducers shall be selectable. MFT shall provide the 15 minute values (configurable 15 minute/1 hour) of Active Energy Import, Active Energy Export, Reactive Energy Import and Reactive Energy Export.

Multi function transducers shall accept nominal 48 V DC as auxiliary power supply. Optionally, MFT can be self powered also. Multi function transducer shall be provided with RS485 interface to communicate with RTU over Modbus protocol in multi-drop mode. Optionally, the MFT with IEC60870-5-101/104 can be used.

The MFTs shall be suitable for mounting on DIN rails. The MFT terminals shall accept upto two 2.5 mm2 / 4 mm2 for PT/CT circuit terminations as applicable.

The MFT shall be programmable with password protection thru suitable facia mounted key pad arrangement so that the configuration parameters such as CT /PT ratio , integration time of energy , reset, communication parameters setting (Address, baud , parity) can be set up at site also. The device shall have LCD displays to visualize all parameters being monitored & configuration etc have configurable at site for CT/PT ratio etc.

6.3. Transducer

The DC transducer (DCT) are of two types.

(i) Voltage

(ii) Current

The Dc Transducer are required to measure battery charger current & voltage shall be suitable for 20% continuous over load and shall be able to withstanding 20 times the normal current rating for a period one second. The DCT shall be able to accept the input upto 120% of the nominal voltage. The DCT shall have low VA burden. DCT shall be mounted in the interface cabinet to be supplied by the contractor. The input range for current & voltage are site specific & hence the same shall be specified RFP floated by UTILITY/state Out put of the device shall preferably be 4-20ma or MODBUS in order to optimize the BOQ. However, as a specific cases the out put in line ranges specified in analog input card in clause for analog input shall be selected. The accuracy of transducer shall be ±0.5%

6.4. Transformer Tap Position Transducer

The transformer tap position indications shall be either of two types based on field requirement..

(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 tuneable 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. Alternatively for RTU, MODBUS link may be used.

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.

6.5. Weather Sensors

Weather sensors shall be installed at one S/S in each town where SCADA/DMS system is getting implemented. All weather sensors shall be maintenance free and of Industry standard design. The design of sensors shall permit calibration on site. The sensing mechanism shall be rugged enough to avoid frequent recalibration.

The sensor, support structure shall have built-in protection against lightning stroke/electrical surges. The output of all the sensors except rainfall sensor shall be 4 to 20 mA at 0-500 ohm impedance. The output of rainfall sensor shall be in the form of potential free contact and its closure shall be accumulated (over a configurable time period) and reported at master station through RTU.

Alternatively, RS 485 with MODBUS protocol may be used. The sensors shall be located in open and in the electrical environment such as outdoor substations. The equipment offered should be suitable for satisfactory operation in the above environment. The Bidder shall submit the details of EMI/EMC compatibility of the sensors and other equipments,

6.6. Wind Speed Sensor

Sensor Anemometer 3 cup assembly, very robust to withstand strong wind gust.

Output	:	4 to 20 mA at 0-500 ohm impedance or RS 485 with MODBUS protocol
Starting Threshold	:	0.5 m/s or better
Range	:	0.9 - 60 m/s
Resolution	:	0.1 m/s
Accuracy	:	2 % or better

Mechanical : 3 Cup assembly and housing (complete), should be very robust and capable to withstand strong wind gust and made up of suitable non-rusting material

Mounting Accessories: Made of suitable good quality material like steel or high strength fibre.

Operating Temperature : 0 o C to + 60 o C (-5 o C to + 55 o C for project area with snowfall history)

Note: The Wind Speed and Wind Direction sensors may be supplied in single enclosure or separately.

6.7. Wind Direction Sensor

Sensor	:	Wind Direction sensor
Output	:	4 to 20 mA at 0-500 ohm impedance or RS 485 with MODBUS protocol
Starting Threshold	:	0.5 m/s or better
Range	:	0 – 360 o (Degrees)
Resolution	:	1o (Degree)
Accuracy	:	3 o (Degrees) or better

Construction of Housing and vane : Housing (complete) should be very robust and capable to withstand strong wind gust and made up of suitable-non-rusting material having high mechanical strength. Wind vane and control head may be of Aluminium or other light UV resistant material

Operating Temperature : 0 o C to + 60 o C(-5 o C to + 55 o C for project area with snowfall history)

Note: The Wind speed and Wind Direction sensors may be supplied in single enclosure or separately.

6.8. Air Temperature Sensor

Sensor	: Air Temperature Sensor
Output	:4 to 20 mA at 0-500 ohm impedance or RS 485 with MODBUS protocol
Temperature Range	:0 o C to + 60 o C(-5 o C to + 55 o C for project area with snowfall history)
Resolution	:0.1o C

Accuracy :< 0.5 o C or better

Radiation Shield :Radiation Shield made of weather resistant material and suitable to sensor used.

6.9. Relative Humidity Sensor

Sensor :Relative Humidity Sensor

Output :4 to 20 mA at 0-500 ohm impedance or RS 485 with MODBUS protocol

Range :0 to 100 %

Resolution :1 %

Accuracy : 3 % or better

Radiation Shield :Radiation Shield made of weather resistant material and suitable to sensor used.

Operating Temperature Range : 0 o C to + 60 o C(-5 o C to + 55 o C for project area with snowfall history)

Note: The Air Temperature and Relative Humidity sensors may be supplied in single enclosure or separately.

6.10. **3.4.5 Rainfall Sensor**

Sensor : Tipping Bucket Rain Gauge

Output : The output of rainfall sensor shall be in the form of potential free contact and its closure shall be accumulated (over a configurable time period) and reported at master station through RTU. Alternatively, RS 485 with MODBUS protocol may be used.

Capacity / Range : Unlimited

Resolution : 0.2 mm per tip or better

Accuracy : ? 4 %

Collecting Area : Minimum 200 sq.mm.

Operating Temperature Range : 0 o C to + 60 o C(-5 o C to + 55 o C for project area with snowfall history)

6.11. Atmospheric Pressure Sensor

Sensor : Atmospheric Pressure sensor

Output : 4 to 20 mA at 0-500 ohm impedance or RS 485 with MODBUS protocol

Range : 600 mb to 1100 mb

Resolution : 1 mb or better

Accuracy : ± 2 % of range

Operating Temperature Range : 0 o C to + 60 o C(-5 o C to + 55 o C for project area with snowfall history)

6.12. Weather Sensor Installation Requirement

The weather sensor shall be supplied along with necessary accessories (e.g. tripod, stand, clamps etc.) for installation/ fixing of sensors, signal/power cables etc. as part of weather sensors station. All the accessories shall be made of stainless steel or other suitable material having sufficient mechanical strength and corrosion resistance to withstand atmospheric temperature, pressure, wind speed and relative humidity up to the working range (Minimum to Maximum) of sensors for these parameters as defined.

The Employer will prefer to install the sensors on roof top of control centre/substation or other building. The mounting arrangement for all the sensors shall be designed suitably for installation on the roof top. The mounting arrangement of the Wind Velocity & Wind Direction sensors shall be of suitable height to avoid obstruction from the nearby structures.

7. Technical Specification For Overhead Fault Passage Indicator

7.1. SCOPE:

This specification covers the technical requirements of design, manufacture, test at manufacturer's works, packing & forwarding, supply and unloading at stores/site and performance of overhead line fault passage indicators to be installed on 6KV to 33 KV over head lines for trouble free and efficient operation. The specific requirements are covered in the enclosed technical datasheet.

7.2. STANDARDS:

The materials shall conform in all respects to the relevant Indian Standards Specification with latest amendments thereto.

S.NO.	Title	Internationally Recognized Standard
1	EMI Immunity	IEC 801-3
2	Outdoor weathering test	IEEE495:2007
3	Temperature cycle test	DIN EN 60068-2-14:2000-08
4	Salt fog test & humidity tests	IEC 60-2-11&68-2-30
5	Short Circuit Standards	ANSI495
6	Dielectric Test	IEC 60060-1
7	Vibrations and Shocks Tests	IEC 68-2-6&68-2-29

7.3. GENERAL TECHNICAL REQUIREMENTS:

	DESCRIPTION	Units	REQUIREMENT
A	Application		
1	Type		Outdoor
2	Distribution Network Voltage	KV	Suitable for 6 KV to 33 KV
3	Power Frequency	Hz	50 Hz
4	Short- circuit withstand	kA/ms	25kA/170 ms
5	HV Neutral arrangement		Solidly grounded
6	Diameter		Suitable for Conductor- Dog, Wolf, Panther, Goat and Zebra.
B	Fault detection parameters		
7	Current setting Trigger value	A	40 A to 1500 A steps of 20 A and Manual and
8	Transient faults detection		On - Off (Manual and Automatic Mode- Can be set on site remotely
9	Minimum impulse time	M sec	40 ms to 300 ms - Manual and Automatic Mode- Can be set on site remotely
10	Beacon Flash Indication Duration (user settable)	min	30 min to 720 min in steps of 30 min - Manual and Automatic Mode- Can be set
11	Inrush transient restraint	sec	2sec

	DESCRIPTION	Units	REQUIREMENT
C	**Reset (Permanent Fault)**		
12	Timer Reset	min	30minto720mininsteps of30 min- Manual and Automatic Mode- Can be set onsite remotely
13	Manual Reset		Manual and Automatic Mode- Can be set on site remotely
D	**Fault indication**		
14	Indication		Bright Red flash light(LEDs)and Red Flag /Disc
15	Light Power	Lumens	40Lumens
16	Visibility Angle	Degree	360Degree
17	Flash Period for permanent faults	Sec	1flashevery3sec (0to2 h)
18	Flash Period for Transient faults	Sec	2flashevery12sec (0to8h)
19	Standard total flash duration	Hrs	1000 hrs
E	**Power Supply**		
20	Battery		Lithium battery
21	Life of the Battery	Years	More than10years
F	**Environment**		
22	Operation Temperature	DegC	-20 deg.C to+70deg.C
23	Storage Temperature	DegC	-20 dec.C to+70 deg.C
24	Protection Level		IP 67
G	**Mechanical**		
25	Wind Resistance	Kg/sq.mm.	For wind pressure 126kg/sq.mup toan elevation of10mts

7.4. TECHNICAL REQUIREMENTS:

7.4.1OverheadFaultPassageIndicator

The Overhead Fault Passage Indicator shall locate the passage of faults on overhead lines. The FPI shall indicate transient faults, temporary faults and permanent faults on the O/H lines. The Overhead Fault Passage Indicator shall operate on passing over of the absolute threshold current(user settable). Current peaks caused by switching on power equipment like transformers etc. can reach the operating point and lead to a wrong evaluation. In order to avoid this, the incoming impulse must be filtered. That means that the fault will only be indicated, if the impulse is longer than the pre-adjusted minimum impulse duration. This duration can be adjusted in the range of 40–300ms.The faults are indicated by all indicators between the net–input and the location of the fault. Therefore, the fault is between the last indicating instrument and the next instrument in standby mode.

7.4.2 Trip Current and fault Types

Trip current for the FPIs shall be settable at site. FPIs shall constantly monitor, measure the line current and evaluate the same. In case current exceeds a pre-set value, a fault must be indicated. Alternatively, there shall also be an “Automatic Mode”, in which the FPIs will get adapted to the service current. The FPI shall detect and indicate phase to phase faults. In addition to this, the FPI shall also detect and differentiate between transient, temporary and permanent faults.

The FPI shall be equipped to filter out the inrush current due to transformer magnetizing currents thus avoiding the possible false indication of faults.

7.4.3 LED/Indication

The FPI shall indicate faults by means of bright red LEDs so that the indication is clearly visible during night times and by means of a red luminous flag, to be clearly visible in the bright sunlight during day times.

7.4.4 Reset

Once the fault is cleared, the FPI shall reset itself upon the power return (If required it shall be possible to disable this automatic reset at site.) It shall also have a facility of resetting with settable time duration and manual reset. If FPI is busy in flashing on transient fault and if the permanent fault occurs, the FPI shall automatically change the priority and shall start flashing differently to show the permanent fault; thus, helping maintenance crew to review the priorities.

7.4.5 Battery

The FPIs shall be powered by inductive pickup from the conductor with a minimum operating current of 20A. During faults, when the system is down, FPIs shall be powered by lithium battery. The lithium battery provided inside the FPI shall be replaceable type, in case of battery failures. The battery shall have a minimum indicating life of 10 years / 800 hours.

7.4.6 Data Transmission Unit

The Data Transmission Unit contains Data Transmission Terminal Unit and Solar Panel.

The DTU receives the measurement and alarming data from the FPI through high frequency wireless module. The frequency band provided by the bidder shall be license free band and congestion free. Range of operation of 1 no DTU shall be min 5 mtr or 1 set (3 no’s) of FPIs. The bidder providing more range of operation shall be preferred. After storing and processing the data, it connects with the SCADA server through GPRS network. According to the agreed communication protocol, it sends the monitoring data to the server and receives the control command sent by the server to achieve bidirectional controllable operation.

The Data Transmission Terminal Unit shall consist of minimum following units:

1. Main Control board/PCB
2. High Frequency wireless module
3. GPRS Module
4. Lead Acid Battery/Battery arrangement to support Solar Panel

7.4.7 Remote Control Unit /Remote Setting

The FPI shall be supplied along with suitable Remote-Control Unit, having an LCD display, common for all the Overhead Fault Passage Indicator. The supplier shall supply Remote Control Unit free of charge along with supply of FPIs. The Ratio of FPI v/s Remote Control Units shall be mentioned in the tender document. The FPI shall be equipped with remote Test and Reset features, so that the functionalities including status of battery and flag can be tested without dismounting the FPI from the line. The following operations shall perform:

i) Perform Test/Reset operations by standing below the FPIs

ii) View settings of various parameters of the FPI like trip current, response time, reset time, temporary fault indication status, transient fault indication status, auto-reclosure support status etc.

iii) Set various parameters of the FPI like trip current, response time, reset time, temporary fault indication status, transient fault indication status, auto- reclosure support status etc.

iv) Perform battery check and flag check.

v) View real-time value of the current flowing though the line on which an FPI is installed. This current shall be indicated in terms o fAmps (A).

vi) Operating range for the Remote-Control Unit shall be minimum 50m radius.

The settings for the FPI shall be settable remotely, without dismounting the FPI from the line. Following parameters shall be settable at time.

a. Trip Current
b. Response Time
c. Reset Time
d. Turn On/Off indication for Transient Faults and Temporary Faults
e. Turn On/Off auto-reclosure support function

7.4.8Installation

The FPIs shall be suitable for installing on overhead line conductors using hot sticks, while the line is in charged condition. The supplier shall supply hot sticks free of charge along with supply of FPIs. The Ratio of FPI v/s hot sticks shall be one per 30 sets of FPI.

7.4.9 Control center interface

The FPIs shall be integrated and made communicable with SCADA/DMS on GPRS Network. FPIs shall be designed such that they can be integrated with SCADA/ GSM Network without dismounting them from overhead line. For SCADA compatibility, the same shall be on IEC-60870-5-104 protocol.

7.5. TEST:

7.5.1 Type Test:

The material offered shall be fully type tested at some recognized test laboratories by the Bidder as per the relevant standards, but test repots shall not be more than five-year-old from the date of opening of bid. The bidder shall furnish four sets of complete type test reports as per relevant IS along with the bid. The bids received without these type test reports shall be treated as Non-responsive.

7.5.2 Acceptance and routine test:

All acceptance and routine tests as stipulated in the relevant standards shall be carried out by the supplier in presence of purchaser's representative at the works of the contractor or the actual manufacturer.

7.6. QUALITY ASSURANCE PLAN:

The successful bidder shall within 30 days of placement of order, submit following information to the purchaser.

i. List of raw materials as well as bought out accessories and the names of sub- suppliers selected from those furnished along with officers.

ii. Type test certificates of the raw materials and bought out accessories, if required by the purchaser.

iii. Quality assurance plan (QAP) withhold points for purchaser's inspection. The quality assurance plan and purchasers hold points shall be discussed between the purchaser and bidder before the QAP is finalized.

7.7. PACKING & FORWARDING:

7.7.1 The equipment shall be packed suitable for vertical/ horizontal transport and suitable to withstand handling during transport and outdoor storage during transit. The supplier shall be responsible for any damage to the equipment during transit, due to improper and inadequate packing. The easily damageable material shall be carefully packed and marked with the appropriate caution symbol. Wherever necessary, proper arrangement for lifting such as lifting hooks etc. shall be provided. Any material found short inside the packing shall be supplied immediately by supplier without any extra cost.

7.7.2 Each consignment shall be accompanied with a detailed packing list containing the following information:

a. Name of the consignment
b. Details of consignment
c. Destination
d. Total weight of consignment
e. Handling and packing instruction.
f. Bill of material and contents of each package.

7.7.3 The supplier shall ensure that the packing list and bill of material are approved by the purchaser before dispatch.

7.7.4 The packing shall be done asper the manufacturer's standard practice. However, he should ensure the packing is such that the material should not get damaged during transit by Rail/Road.

7.7.5 The marking on each package shall be as per the relevant standards and shall also contain "Smart Grid/respective DISCOM".

7.7.6 Packing shall be robust enough for rough handling during transportation.

7.7.7 The ends of all the cables should be capped & suitably scaled by means of non- hygroscopic material.

7.8. GUARANTEED TECHNICAL PARTICULARS FOR OVERHEAD FAULT PASSAGE INDICATOR:

S.No.	DESCRIPTION	Units	REQUIREMENT
A	**Application**		
1	Type		
2	Distribution Network Voltage	KV	
3	Power Frequency	Hz	
4	Short–circuit withstand	kA/ms	
5	HV Neutral arrangement		
6	Diameter		
7	License Free Radio Frequency	As per the Bidder	
B	**Fault detection parameters**		
8	Current setting Trigger value	A	
9	Transient faults detection		
10	Minimum impulse time	M sec	
11	Beacon Flash Indication Duration (user settable)	min	
12	Inrush transient restraint	sec	
C	**Reset (Permanent Fault)**		
13	Automatic Power Return	A	
14	Timer Reset	min	
15	Manual Reset		
D	**Fault indication**		
16	Indication		
17	Light Power	Lumens	
18	Visibility Angle	Degree	
19	Flash Period for permanent faults	Sec	
20	Flash Period for transient faults	Sec	
21	Standard total flash duration	Hrs	
E	**Power Supply**		
22	Battery		
23	Life of the Battery	Years	
F	Environment		
24	Operation Temperature	Deg C	
25	Storage Temperature	Deg C	

S.No.	DESCRIPTION	Units	REQUIREMENT
26	Protection Level		
G	Mechanical		
27	Wind Resistance	Kg/sq.mm.	
28	Weight	Kg	
29	Dimensions	mtr	

8. AUXILIARY POWER SUPPLY SYSTEM

8.1. General

This section describes the technical requirements for Auxiliary Power Supply System. The BOQ for Auxiliary Power Supply system equipment's required for SCADA/DMS-OMS control centre, RTU/Data Concentrator, FRTU Communication equipment & remote VDU locations The components of Auxiliary Power Supply system are Uninterruptible Power Supply (UPS), 48V DC power supply (DCPS), the batteries for UPS and DCPS. The technical requirements for all the above components are described in the various subsequent clauses.

The Bidder is encouraged to offer their standard products and designs. The UPS, DCPS, Battery shall be manufactured & tested as per the relevant IS/IEC/ EN/BS standards. However, the Bidder shall conform to the requirements of this specification and shall provide any special interface equipment necessary to meet the requirements stated herein.

All equipment except Batteries shall be designed for an operating life of not less than 15 years, however, batteries shall have a minimum expected operating life of 5 years under normal operating conditions or 1200 charge/discharge cycles (which ever is earlier). The Contractor shall demonstrate the functionality of the equipment during tests in the factory. After the equipment is installed, the Contractor shall demonstrate all of the functions during well-structured field tests.

8.2. Uninterruptible Power Supply (UPS)

The technical requirements for the Uninterruptible Power Supply (UPS) System and associated equipments to be provided by the contractor are described below.

The UPS system shall include the following:

a. UPS equipments supplying load at 0.8 lagging power factor
b. VRLA batteries for UPS system with backup duration
c. UPS input and output AC Distribution Boards.
d. Power, control and network cables

8.3. UPS Functions

The UPS shall be designed for continuous-duty, on-line operation and shall be based on solid-state design technology to provide uninterrupted power supply for computer system and associated items. The control of the UPS system shall be microprocessor based providing monitoring and control of rectifier/charger, Inverter, static switches, firing and logic control.

Each UPS system provided by the Contractor shall include all of the following sub-systems as well as any other components and support hardware necessary for complete and proper operation of the UPS:

a. Rectifier/charger unit
b. Inverter unit
c. Battery Low Voltage Disconnect device
d. Static bypass switches
e. Manual maintenance bypass switches
f. Isolation transformer
g. Load transformer and filters
h. Control panels including source selection equipment & ACDBs, automatic controls and protection
i. Hardware and software as required for parallel operation of two no of UPS systems
j. All necessary cables, MCCBs/MCBs/ switches/ fuses

In the event of a loss of AC source, the UPS equipment shall provide uninterrupted power to the critical loads from the output of the UPS inverter subsystems through batteries.

8.4. UPS Operation

The UPS systems with associated batteries shall operate in parallel redundant configuration sharing the connected load.

The UPS shall primarily use the inverter subsystem to deliver AC power to the computer loads. In case of failure of any one of UPS, the other healthy UPS shall continuously supply the power to the computer loads without any interruption. If the other healthy UPS also fails then automatically Static bypass of UPS shall start supplying the connected load through AC mains without any interruption.

The Manual Maintenance Bypass shall be provided for each of the UPS separately to extend AC raw power supply to computer systems in case of complete failure or shutdown of UPS systems.

The facilities shall also be provided to manually control the UPS through its control panel.

8.5. UPS Equipment Design

The design of the UPS shall have the capability to isolate any failed piece of equipment viz. Rectifier/charger unit, inverter and battery for maintenance. UPS equipment design shall consider the following electrical parameters:

a. UPS equipment shall comply to IEC 62040 or equivalent. EN/BS standards for design, performance and EMC requirements.
b. The input mains AC supply to the UPS shall be 415 volt AC, 3-phase, 4-wire, 50 Hz. The input supply voltage may vary +10% to -15% from nominal and the frequency may vary from 47.5 to 52.5 Hertz.
c. The UPS shall be suitable for operation on Mains input AC on phase sequence reversal.
d. The UPS shall provide 3-phase four wire output plus ground.
e. The UPS shall supply power to the connected loads at 415 volt AC, 3-phase, 50 Hz., 0.8-lagging power factor.
f. The UPS shall provide continuous regulated sine wave AC power to the connected loads.
g. The overall efficiency of the UPS, input to output, shall be a minimum of 90 percent with the batteries fully charged and operating at full load and unity power factor.
h. Noise generated by the UPS under normal operating condition shall not exceed 78 dB measured five (5) feet from the front of the cabinet surface.

The requirements of each sub-system of UPS are detailed below:

a. Rectifier/Charger Units

Each rectifier/charger unit output voltage shall be regulated to match the characteristics of the batteries and inverter. The rectifiers/chargers shall provide voltage regulated DC power to the invertors while also charging and maintaining the batteries at full capacity.

The rectifier/charger units shall have the following characteristics:

i. Input Voltage and frequency characteristics as per clause 4.1.3 above.
ii. Input current limit of 125 percent of the nominal full load input current
iii. Maximum input current total harmonic distortion of 5 percent at nominal input voltage and under full load.
iv. The output shall be current limited to protect the rectifier/charger unit circuitry and to prevent the batteries from over-charging.
v. Capacity to recharge the batteries to 90% of its capacity (from fully discharged state i.e. ECV of 1.75) within 8 hours while carrying full load.

vi. Automatic equalizing after partial discharge of the batteries.
vii. Temperature dependent battery charging with temperature sensing probes mounted on the battery banks.
viii. Automatic float cum boost charging feature.

b. Inverter

The invertors shall normally operate in synchronism with the mains AC power source. Upon loss of the mains AC power source or its frequency deviating beyond a preset range, the invertors shall revert to their own internal frequency standard. When the mains AC source returns to normal, the invertors shall return to synchronized operation with the mains AC source. Such reversal of operation of inverters from synchronous to free running mode and vice-versa shall not introduce any distortion or interruption to the connected loads. A suitable dead band for frequency may be provided to avoid unnecessary frequent reversal of inverter operation between free running mode and synchronised mode under fluctuating frequency conditions.

The invertors shall have the following characteristics:

i. cInverter unit shall be based on Pulse Width modulation (PWM) technique.
ii. The nominal output voltage shall be 415 Volt ±1%, 3-phase, 4-wire AC up to rated load.
iii. The transient voltage response shall not exceed 4% for the first half-cycle recovering to 1% within ten cycles for a 100 percent step load application or removal.
iv. The free running frequency shall not deviate by more than + 0.1 % for the rated frequency of 50 Hz.
v. The invertors shall be synchronized to the main AC source unless that source deviates from 50 Hz by more than 1% (adjustable to 1/2/3/4/5 %).
vi. The output voltage harmonic distortion shall not exceed 5% RMS and no single harmonic component shall exceed 3%.
vii. The invertors shall be capable of resistive load operation & deliver at least 80% of the nominal capacity at the rated power factor and be capable of operation with loads ranging from the rated through unity power factor. Inverter shall also accept 100% load at crest factor of at least 3:1 for Switching Mode Power Supply (SMPS) load of computer system equipments without de-rating.
viii. The invertors shall provide protection logic to automatically shut down and isolate itself from the load when the battery voltage drops below a preset voltage.
ix. The invertors shall provide interrupter switch to isolate the unit from the load on failure of the unit. The interrupter switch shall be rated to carry full continuous load and to interrupt the inverter under full fault load.
x. The invertors shall be capable of supporting a start-up surge or overload of 150 percent of rated output for up to 60 seconds.

In case the inverter subsystem does not include an internal load transformer, an external load transformer of delta-wye configuration, 3-phase, 50Hz, 415 V AC, suitable for the inverter shall be provided.

c. Static Bypass Switches:

Each UPS system shall include static bypass switch to facilitate automatic transfer of loads from the inverter sub-system output to bypass AC source though isolation transformer. Isolation transformer shall be rated for atleast two times the rating of single UPS sub system. However, in case of parallel-redundant UPS systems, the transfer to Static bypass must occur only when the invertors of both the UPS systems have failed.

The transfer to Static Bypass from the inverter shall take place under the following fault conditions:

i. The inverter load capacity is exceeded
ii. An over- or under-voltage condition exist on the inverter output
iii. Inverter failure.

The static bypass switches shall be high-speed devices rated to transfer and carry full rated load. The static bypass switches shall provide protection to prevent out of phase transfers. The switching speed of the static bypass switches shall be less than 1 millisecond. During the changeover, the output voltage should not fall below 205V A.C., 50Hz +5%, in order to avoid any disruption to computer load supply. An automatic transfer back to the inverter subsystem shall occur if the transfer from the inverter subsystem was caused by a temporary overload and the load has returned to normal or by a temporary over/under voltage condition on inverter output and the voltage has returned to normal. The transfer back to the inverter subsystem, both automatic and manual, shall be inhibited under the following conditions:

i. The frequency of bypass AC source is outside the frequency band of ±1% of 50Hz (adjustable to 1/2/3/4/5 percent).
ii. The inverter output voltage and frequency are beyond the preset range.
iii. An overload exists.

d. Manual Maintenance Bypass Switches

Manual bypass switches are provided to facilitate maintenance of the UPS system and shall provide transfer of the connected load from one UPS output to the other UPS system. These switches shall be rated to transfer and carry continuous full rated load.

e. **Batteries**

UPS system shall have a set of storage batteries designed for continuous UPS application. The battery set shall have sufficient capacity to maintain output at full rated load for the specified backup duration after 8 hour charging. The backup duration of the battery shall be as specified in the BOQ. The battery set shall be maintenance free VRLA type Batteries. The detailed requirement of batteries is given under clause 4.4

f. Battery Breaker for UPS system

A 2-pole MCCB of suitable rating shall be provided near the battery bank (at suitable location on the frame of the battery bank) to allow disconnection of the batteries from the rectifier/charger unit and inverter. This shall also provide over-current protection to the battery circuits.

g. UPS Control/Monitoring

The Contractor shall supply control panel to permit automatic & manual operation of UPS, display of associated alarms and indications pertaining to the UPS. In each UPS system, a local display of the following analog and status/alarm signals/indications as a minimum shall be included:

i. Analog signals for the following measurements:
ii. AC input voltage (to display each phase)
iii. AC output voltage (to display each phase)
iv. AC output current (to display each phase)
v. AC input mains Frequency
vi. AC UPS Output Frequency
vii. DC voltage (battery subsystem)
viii. DC current (battery subsystem)

Status/Alarms signals for the following indications :

i. Parallel operation of inverters
ii. Inverters running in synchronised / free running mode.
iii. Battery Low voltage alarm (battery subsystem)

iv. Load on battery alarm
v. Battery Circuit Breaker Open alarm
vi. Overload trip alarm
vii. High-temperature alarm
viii. Equipment failure alarm

For remote monitoring a wall mounted type panel consisting of audio visible alarm or PC based monitoring system shall be provided in the control room. For PC based monitoring system required computer hardware and software shall be provided by the contractor. The monitor of PC shall be 15" TFT type.

h. Internal Wiring

All internal wires shall be of stranded copper conductor, sized according to the current requirements with minimum insulation rating of 1100 VAC. Extra-flexible wire shall be used for all circuits mounted on door or swing panels within the UPS

i. Enclosures/Panels design

The UPS electronic equipment and associated circuitry & all devices shall be housed in a freestanding enclosures/panels. Modules and sub-assemblies shall be easily replaceable and maintainable. Cable entry shall be from the bottom/top of the enclosures (to be finalized during detailed engineering). The applicable degree of protection of enclosures shall be IP20 however, suitable protection shall be provided against vertical dripping of water drops. UPS shall be installed with the necessary base frame including anti-vibration pad. The thickness of the structural frames and load bearing members shall be minimum 2.0 mm and for front & rear, sides, bottom and top covers shall be minimum 1.6 mm. For other requirement of enclosure/panel, clause 4.2.3.4 may be referred.

j. Equipment / Panel Earthing

Each enclosure shall include suitable signal & safety earth networks within the enclosure. The signal-earthing network shall be separate & terminated at a separate stud connection, isolated from safety earth network. Each earth network shall be a copper bus bar, braid or cable. The contractor shall connect safety and signal earths of each enclosure to the earth grid/earth riser through suitable 50X6 sq. mm. GI strips. For other requirement of enclosure/panel earthing, clause 4.2.3.5 may be referred.

k. External Power Connections Error! Bookmark not defined.

All breakers/switches shall be suitably rated to match the requirement of external power connections.

8.6. Testing of UPS

a. Type Test of UPS

The Contractor shall supply type tested UPS equipments. The Contractor shall submit the UPS type test reports of earlier conducted tests (including performance & EMC requirements) on the same make, model, type & rating as offered, as per IEC 62040 or equivalent EN/BS standards. For type testing requirements in addition to provisions of section 7 is also to be complied.

b. Factory Acceptance Test of UPS

A factory acceptance test shall be conducted on all the equipments and shall include, but not be limited to the following, appropriate to the equipment being tested:

a. Verification of all functional characteristics and requirements specified
b. Voltage drop and transients generated during switching operations
c. System efficiency tests

d. Verification of all features and characteristics included in all the delivered equipments and also as per specification requirements.
e. Inspection and verification of all construction, wiring, labelling, documentation, and completeness of the hardware

Before the start of factory testing, the Contractor shall verify that all change orders applicable to the equipment have been installed. As a part of the factory tests, unstructured testing shall be performed to allow Employer representatives to verify proper operation of the equipment under conditions not specifically tested in the above structured performance test. A minimum of 8 hours of the factory test period shall be reserved for unstructured testing. The Contractor's test representative shall be present and the Contractor's technical staff members shall be available for consultation with Employer personnel during unstructured test periods. All special test facilities used during the structured performance test shall be made available for Employer's use during unstructured testing.

The respective factory acceptance tests for UPS are listed in Table 4.1

8.7. Environmental Conditions Error! Bookmark not defined.

UPS & all other hardware and components shall be capable of continuous operation at rated load without failures in the following environmental conditions:

Temperature/humidity - Ambient temperature of 00 to 500C and upto 95 percent humidity, non-condensing. However, air conditioned environment shall be provided for VRLA batteries.

Table 4.1 LIST OF FACTORY & SITE TESTS FOR UPS

Sl. No.	Test	Factory Acceptance Tests	Site Tests
1.	Interconnection Cable Check	√	√
2.	Light Load Test	√	
3.	UPS Auxiliary Devices Test	√	√
4.	A.C. input failure Test	√	√
5.	A.C. input return Test	√	√
6.	Simulation of parallel redundant UPS fault	√	
7.	Transfer Test	√	√
8.	Full Load Test	√	√
9.	UPS Efficiency test	√	
10.	Unbalanced Load test	√	
11.	Balanced Load test	√	
12.	Current division in parallel or parallel redundant UPS test	√	
13.	Rated stored energy time test (Battery test)		√
14.	Rated restored energy time test (Battery test)		√

Sl. No.	Test	Factory Acceptance Tests	Site Tests
15.	Battery ripple current test		√
16.	Overload capability test	√	
17.	Short circuit test	√	
18.	Short-circuit protection device test	√	
19.	Restart test	√	√
20.	Output Over voltage test	√	
21.	Periodic output voltage variation test	√	
22.	Frequency variation test	√	
23.	Harmonic Components test	√	
24	Earth Fault test	√	
25.	On site ventilation test		√
26.	Audible noise test	√	
27.	Parameter/Configuration settings	√	√
28.	Phase Sequence Test	√	√
29	Coordination and discrimination of Tripping of associated breakers (MCCB/MCBs) in upstream & down stream		√

8.8. AC DISTRIBUTION BOARDS

AC distribution boards shall be provided for UPS input and output power distribution. The distribution boards shall distribute power and provide protection against failures on feeder circuits, to the equipment. The Contractor shall be responsible for design, engineering, manufacturing, supply, storage, installation, cabling, testing & commissioning of AC distribution boards required for distribution of power. The nominal input frequency is 50 Hz, which may vary from 47.5-52.5Hz. The phase to neutral input voltage shall be (Nominal 240V) varying from 190V to 265 V.

The Input ACDB will cater for the load requirements of DC power supply system, air-conditioning alarm system, fire protection alarm system, lighting loads and one spare of 20A minimum, in addition to UPS system load. The Output ACDB shall cater for only critical loads in the control centre. The number of feeders and their ratings in the output ACDB shall be decided during detail engineering. At least five spare feeders in the output panel shall be provided.

All MCCBs shall conform to IEC-60947-2 & IS 13947-2/IEC 947-2, IEC-60898 and IS 8828 and shall be of Four (4)Pole type of requisite rating. MCBs used for load feeders in output ACDB shall be of minimum curve B characteristics. The load feeders shall be coordinated with requirement of loads of computers and other loads.

8.9. Enclosures/Panels

The equipments of ACDBs shall be physically mounted in freestanding enclosures/panels. MCCBs and sub-assemblies shall be easily replaceable and maintainable. Cable entry shall be from the bottom/top of the enclosures (to be finalized during detailed engineering). The Contractor shall state the type, size and weight of all enclosures and indicate the proposed manner of installation. The applicable degree of protection of enclosures shall be at least IP21. The thickness of the structural frames and load bearing members shall be minimum 2.0 mm and for front & rear, sides and top covers shall be minimum 1.6 mm. For wall mounted type of output ACDB the above requirements shall not be applicable.

8.10. Equipment/Panel Earthing & Surge Protection

Each enclosure shall include suitable safety earth networks as per clause 4.2.3.5. . Surge protection devices shall be installed in the input ACDB to provide adequate protection against current and voltage transients introduced on input AC due to load switching surges. These protection devices shall be in compliance with IEC- 61312, IEC- 61024 and VDE 0100-534 for following surges:

a) Low Voltage Surges (Class C)

Between	Requirement
R, Y, B & N	In ≥ 10 kA, 8/20 µS for each phase
N & PE	In ≥ 20 kA, 8/20 µS

In= Value of Nominal Discharge Current.

8.11. CABLING REQUIREMENTS

The contractor shall supply, install and commission all power cables, control cables, network interface cables and associated hardware (lugs, glands, cable termination boxes etc.) as required for all equipment. The contractor shall be responsible for cable laying and termination at both ends of the cable. The Contractor shall also be responsible for termination of owner supplied cables if any at contractor's equipment end including supply of suitable lugs, glands, terminal blocks & if necessary cable termination boxes etc. All cabling, wiring and interconnections shall be installed in accordance with the following requirements.

8.12. Power Cables

All external power cables shall be stranded aluminium/Copper conductor, armoured XLPE/PVC insulated and sheathed; 1100V grade as per IS 1554 Part-I. The conductor for the Neutral connection from UPS to Output ACDB shall be sized 1.8 times the size of the Phase conductors to take care of the non-linear loads. However, the cable between UPS & Battery bank shall be of copper conductor (armoured type).

8.13. Cable Identification

Each cable shall be identified at both ends, which indicates the cable number, and the near-end and far-end destination. All power cables shall have appropriate colour for identification of each phase/neutral/ground. Cable marking and labelling shall comply with the requirements of the applicable standards.

8.14. Cable and Hardware Installation

The Contractor shall be responsible for supplying, installing, and terminating all cables and associated hardware (lugs, glands, etc.), required to mechanically and electrically complete the installation of facilities for the project.

8.15. Enclosures/Panels design

Enclosures/panel shall be of freestanding type of design. Cable entry shall be from the bottom/top of the enclosures (to be finalized during detailed engineering). The enclosures shall not have doors that are wider than 80 cm and doors shall be hinged with locking as per standard design of the manufacturer. Keyed locking is required with identical keys for all enclosures. The enclosures shall not exceed 220 cm in height. The thickness of the structural frames and load bearing members shall be minimum 2.0 mm and for others shall be minimum 1.5 mm. The panels/boards shall be equipped with necessary cable gland plates. The Contractor shall state the type, size and weight of all enclosures and indicate the proposed manner of installation.

Wiring within panel 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.

Conductors in multi-conductor cables shall be individually colour coded, and numbered at both ends within enclosures.

The enclosures shall be painted inside and outside. The finish colour of all enclosures shall be aesthetically pleasing and shall be approved by the owner. Further, finish colour of external surfaces shall be preferably of same colour for all enclosures/panels.

Maintenance access to the hardware and wiring shall be through full height lockable doors.

Each panel shall be supplied with 240 VAC, 50Hz single-phase sockets with switch.

Each ACDB and equipment within ACDB enclosures shall be clearly labelled to identify the enclosure/equipment. All labelling shall be consistent with Contractor-supplied drawings.

8.16. Enclosure/Panel Earthing

Each enclosure shall include suitable earth networks within the enclosure. Earth network shall be a copper bus bar, braid or cable inside enclosures.

The safety earth network shall terminate at two/more studs for connecting with the earthing grid. Safety earthing cables between equipment and enclosure grounding bus bars shall be of minimum size of 6 mm2, stranded copper conductors, rated at 300 volts. All hinged doors shall be earthed through flexible earthing braid.

For all enclosures requiring AC input power, the green earthing wire from the AC input shall be wired to the safety-earthing stud. The Contractor shall provide all required cabling between enclosures for earthing. The contractor shall connect safety and signal earths (as applicable) of each enclosure to the nearest earth grid/earth riser through suitable 50X6 sq. mm. GI/25x3 Cu strips. The contractor may use the existing grid wherever available. In case the suitable earthing grid is not available the same shall be made by the contractor.

The signal earthing network shall terminate at a separate stud connection, isolated from safety ground. The stud connection shall be sized for an external earthing cable equipped with a suitable lug.

All earthing connections to equipment shall be made directly to each equipment chassis via earthing lug and star washer. Use of the enclosure frame, skins, or chassis mounting hardware for the earthing network is not acceptable.

8.17. DC POWER SUPPLY SYSTEM

The DC Power Supply system shall be capable of meeting the load requirements for various Telecom equipments, RTUs and other associated equipment located at indoor, i.e. at the substations, the control centers and customer care system. The AC input to the ACDB shall be provided from the ACDB described under clause 4.2 at control center. At other locations the AC input to the DCPS system shall be single phase AC which will be provided from the existing system. At these locations the class B & C level of surge protection (between phase-neutral and neutral – protective earth) as specified under and conforming to IEC 61312, IEC 61024 and VDE 0100-534 shall be installed in the DCPS system.

Surge protection devices shall be installed in the DCPS panel to provide adequate protection against current and voltage transients introduced on input AC due to load switching and low energy lightning surges. These protection devices shall be in compliance with IEC- 61312, IEC- 61024 and VDE 0100-534 for following surges:

a) Lightning Electromagnetic impulse and other High Surges (Class B):

Between	Requirement
Ph & N	Iimp ≥ 50 kA, 10/350 µS for each phase
N & PE	Iimp ≥ 100 kA, 10/350 µS

Iimp= Value of Lightning Impulse Current

b) Low Voltage Surges (Class C)

Between	Requirement
Ph & N	In ≥ 10 kA, 8/20 µS for each phase
N & PE	In ≥ 20 kA, 8/20 µS

In= Value of Nominal Discharge Current.

8.18. General Technical Requirements for SMPS based DC power supply units

SMPS based DC power supply system is to be used in Auto Float-cum-Boost Charge mode as a regulated DC Power source. DCPS system is to be installed indoors and shall be provided with IP21 panels. The System shall consist of the following:

8.19. SMPS modules

Controller module to control and monitor all DCPS modules.

The number and rating of SMPS modules shall be provided as per the Employer's requirements stipulated in the BOQ. The Panel, Distribution/Switching arrangement shall be provided for the ultimate system capacity. Ultimate System capacity is defined as 150% of the present capacity specified. The ultimate capacity is over and above the requirement of redundancy wherever specified. All factory wiring for the panel shall be for the ultimate capacity so that only plugging-in of SMPS module shall enhance the DC power output. The size of fuses, MCBs, switch, bus etc shall be suitable for the ultimate capacity.

The system shall be sufficiently flexible to serve any load depending on manufacturer's design, rating and number of SMPS modules used in panel and system configuration. To cater for higher load requirements, same type of SMPS modules mounted in the same rack or different racks shall be capable of working in parallel load sharing arrangement. The DCPS system shall be suitable for operation from single phase A.C. mains.

8.20. Operational/Component Requirements

The basic modules shall operate at specified ratings and conform to requirements stipulated in this specification. The DCPS system shall meet requirement of the latest TEC specification / IEC/BS for other parameters not specified in this specification. The component parts of the equipment shall be of professional grade of reputed manufacturer to ensure prompt and continuous service and delivery of spare parts. The component shall confer to relevant IEC/IS standards. The contractor shall obtain Employers approval of major component before procurement of the same. Conceptual diagram is for DCPS is shown in figure 4-2.

The DCPS shall be suitable for operation at ambient temperature of 0-50 deg and relative humilities up to 95 %.

8.21. Wiring

All insulated conductors except those within the confines of a printed circuit board assembly shall be of the rating enough to withstand the maximum current and voltage during fault and overload. All insulated conductors/cables used shall conform to IS 1554 or equivalent international standard.

All wiring shall be neatly secured in position and adequately supported. Where wires pass through any part of metal panel or cover, the hole through which they pass shall be suitably secured.

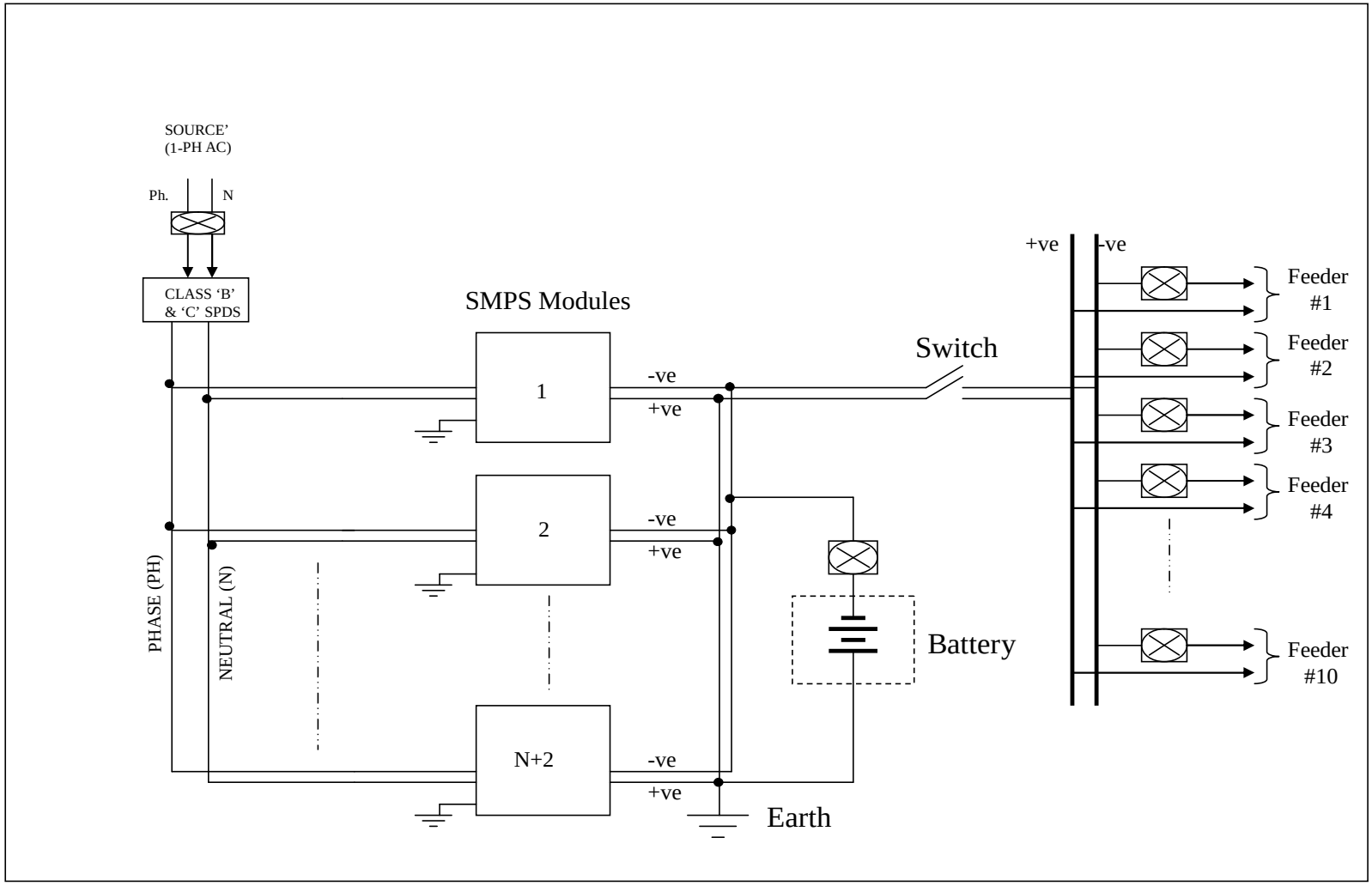
8.22. Bus Bars

High conductivity Cu bus bar shall be provided and shall be sized to take care of the current of ultimate DCPS system capacity for which it is designed. However, it shall not be less than 25mm X 5mm.

8.23. Earthing

Two earth terminals shall be provided in the frame of the system. The Contractor shall connect these earth terminals to the earth bus. All modules and devices shall be connected to these earth terminals. The hinged door shall be connected to the panel with braided Cu at two point at least.

FIG. 4-2 : CONCEPTUAL CONFIGURATION OF DC POWER SUPPLY (DCPS) SYSTEM



8.24. Finish and Painting

The finish of Steel/Aluminum alloy structure and panels shall conform to relevant IS specification (or equivalent international specifications). The colour scheme for panel, Door and Modules shall be decided during detailed engineering.

8.25. Marking and Labelling of Cables

The Contractor shall propose a scheme for marking and labeling the inter panel cables and get it approved from the Employer. A cabling diagram, screen printed or any other better arrangement ensuring better life expectancy shall be placed in the inside of the front door or any other convenient place for ready reference of the maintenance staff.

8.26. Name Plate

A name plate etched, engraved, anodized or any other better arrangement ensuring better life expectancy shall be suitably fixed on each panel /module and contain at least the following information :

a. Type of the Unit / Model No
b. Manufacturer's Name and identification
c. Unit serial No
d. Year of manufacture
e. Input voltage and phase
f. Output Voltage and Current

8.27. System and Panel Configuration

The mechanical and electrical requirements of the Panel are described as below:

8.28. System Configuration

The SMPS modules shall be accommodated in panels. The system shall employ a modular configuration to provide flexibility, keeping in view the future load requirements of DC Power. The system shall be configured for ultimate capacity as brought out in Section 4.3.1 General Technical Requirements. The control, Monitoring, Alarm arrangement and DC & AC distribution shall be provided suitably in the panel.

The number of SMPS modules to be provided in the DCPS system shall be provided in N+ 2 configurations, where N is the number of SMPS modules to meet the battery charging current (10% of C10 AH Capacity) of the offered battery plus the load requirement stipulated in the BOQ. The current rating of each module shall be considered as output current of the SMPS module at nominal voltage (48V).

It shall be possible to easily mount/remove the modules from the front side of the panel. The SMPS modules/SMPS module sub-racks shall be designed to slide into the panels and fixed securely by a suitable mechanical arrangement.

8.29. Constructional Features of Panel

Panel (Enclosure) shall be freestanding type of design. Cable entry shall be from the bottom/top of the enclosures (to be finalized during detailed engineering). The enclosures shall not have doors that are wider than 80 cm and doors shall be hinged with locking as per standard design of the manufacturer. Keyed locking is required with identical keys for all enclosures. The enclosures shall not exceed 220 cm in height. The thickness of the structural frames and load bearing members shall be minimum 2.0 mm and for others shall be minimum 1.5 mm. The panels/boards shall be equipped with necessary cable gland plates. The Contractor shall state the type, size, and weight of all enclosures and indicate the proposed manner of installation.

Wiring within panel 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. Conductors in multi conductor cables shall be individually colour coded, and numbered at both ends within enclosures.

The enclosures shall be painted inside and outside. The finish colour of all enclosures shall be an aesthetically pleasing and shall be approved by the owner. Further, finish colour of external surfaces shall be preferably of same colour for all enclosures/panels.

Maintenance access to the hardware and wiring shall be through lockable, full height, from doors.

Each panel shall be supplied with 240 VAC, 50Hz single-phase sockets with switch and lighting lamp for panel illumination.

The manufacturer so as to ensure the uninterrupted use of the equipment shall do proper thermal engineering of hardware design. The Panel shall be designed to allow cooling preferably by natural convection. The Bidders shall submit detail design of proposed Panel/enclosure and heat dissipation calculations during detailed engineering. Forced cooling is permitted (DC Fans are permitted in the Panel or SMPS module) for equipment mounted indoors (buildings/rooms/shelters). If cooling is provided at Panel level it shall be provided with additional fan with facility for manual switch over. Proper filtering shall be provided to control dust ingress. There shall be an arrangement for automatic Switching-OFF of fans during AC input failure. The required individual modules may be separated by air baffle to provide effective convection. The manufacturer shall also ensure that the failure of fan does not cause any fire hazards. The failure of any of the fans shall draw immediate attention of the maintenance staff.

8.30. Electrical Requirements:

AC input supply: The nominal input frequency is 50 Hz, which may vary from 47.5-52.5Hz. The input voltage shall be single phase (Nominal 240V) varying from 190V to 265V. There shall be an automatic arrangement for shutting off of the SMPS module whenever the input voltage is beyond the specified operating limits with suitable alarm indication. The SMPS module shall resume normal working automatically when the input is restored within the working limits. Hysteresis within specified working limits shall not cause shutting down of the SMPS. A tolerance of ±5V may be acceptable for protection & alarm operation.

8.31. DC output Characteristics of Modules

The module shall be capable of operating in "Auto Float-cum-Boost Charge" mode depending on the condition of the battery sets being sensed by the Control unit.

a. The float voltage shall be continuously adjustable & pre-settable at any value in the range of –48 to –56V either at the module or may be set from the common controller configuration. Further, the prescribed float voltage setting shall be based on recommendations of the VRLA battery supplier.
b. In Boost charge mode SMPS shall supply battery & equipment current till terminal voltage reaches set value, which is normally 2.3V/cell (55.2V) or as recommended by the VRLA battery supplier & shall change over to constant voltage mode
c. The DC output voltage variation shall not be more than 2% for load variation from 25% load to full load.

8.32. Current Limiting (Voltage Droop)

The current limiting (Voltage Droop) shall be provided in DCPS modules in float and boost charge modes of operation. The float/boost charge current limiting shall be continuously adjustable between 50 to 100% of rated output current for output voltage range of –44.4 volts to –56 Volts.

The float and boost charge current limit adjustment shall be provided in the DCPS system. The SMPS modules shall be fully protected against short circuit. It shall be ensured that short circuit does not lead to any fire hazard.

8.33. Soft/Slow Start Feature:

Soft/Slow start circuitry shall be employed such that SMPS module input current and output voltage shall reach their nominal value within 10 seconds.

The maximum instantaneous current during start up shall not exceed the peak value of the rectifier input current at full load at the lowest input voltage specified.

8.34. Voltage overshoot/Undershoot:

The requirements of (a) to (c) given below shall be achieved without a battery connected to the output of SMPS module.

a. The SMPS modules shall be designed to minimize DC output voltage Overshoot/Undershoot such that when they are switched on the DC output voltage shall be limited to ± 5% of the set voltage & return to their steady state within 20 ms for load variation of 25% to 100%.
b. The DC output voltage overshoot for a step change in AC mains as specified in clause 4.3.12 Electrical Requirements shall not cause shut down of SMPS module and the voltage overshoot shall be limited to ± 5% of its set voltage and return to steady state within 20ms.
c. The modules shall be designed such that a step load change of 25 to 100% and vice versa shall not result in DC output voltage Overshoot/Undershoot of not more than 5% and return to steady state value within 10 ms without resulting the unit to trip.

8.35. Electrical Noise:

The Rectifier (SMPS) Modules shall be provided with suitable filter at output with discharge arrangements on shut down of the modules. The Psophometric Noise and ripple shall be as per relevant standards.

8.36. Parallel Operation

SMPS modules shall be suitable for operating in parallel with one or more modules of similar type, make and rating, other output conditions remaining within specified limits.

The current sharing shall be within ± 10% of the average current per rectifier module individual capacity of each rectifier module in the system (mounted in the same or different Panels) when loaded between 50 to 100% of its rated capacity for all other working conditions.

8.37. Protection

The SMPS module, which has failed (for any reason) shall be automatically isolated from the rest of the modules and an alarm shall be initiated for the failure.

8.38. DC Over voltage protection

DCPS shall be fitted with an internal over voltage protection circuit.

In case output DC voltage exceeds –57V or as per the recommendations of the manufacturer of batteries, the over voltage protection circuit shall operate & shut off the faulty module. A tolerance of ± 0.25V is permitted in this case.

Shutting off of faulty SMPS module shall not affect the operation of other SMPS modules operating in the Panel. Operation of over voltage shut down shall be suitably indicated and extended monitoring/control unit. The circuit design shall ensure protection against the discharge of the Battery through the SMPS module in any case. The over voltage protection circuit failure shall not cause any safety hazard.

8.39. Fuse/Circuit Breakers

Fuses or miniature circuit breakers (MCB) shall be provided for each SMPS module as follows:

a. Live AC input line
b. Control Circuit
c. All fuses/circuit breaker used shall be suitably fault rated.

8.40. AC Under/Over Voltage Protection

AC input Under/Over voltage protection shall be provided as per clause 4.3.12 for Electrical Requirements.

8.41. Over Load/Short Circuit Protection

The SMPS shall be protected for Over load/Short circuit as per clause 4.3.14 Current Limiting (Voltage Droop).

8.42. Alarms and indicating lamps

Visual indications/display such as LEDs, LCDs or a combination of both shall be provided on each SMPS module for detection of SMPS module failure.

8.43. Termination

Suitable termination arrangements shall be provided in the panel for termination of inter cubicle cables from other equipment such as owners ACDB, Telecom and other associated equipments and alarm cables. All the termination points shall be easily accessible from front and top. AC and DC terminals shall be separated by physical barriers to ensure safety. All the terminals except AC earth shall be electrically isolated.

8.44. DC Terminations

All terminations including through MCBs shall be through lock and screw type terminations. Load and batteries shall be connected to DCPS through appropriate MCBs. The isolation of any of the battery from the load shall create an alarm. DC distribution shall be provided with adequate no of feeders (with three no of spare) with appropriate MCBs (6 Amp thru 32 Amp) for termination of the loads. Actual rating of the MCBs and no of feeders shall be finalized during the detail engineering. DC distribution may be done either on wall mounted panel or on the DCPS panel. The proper rated MCB shall be provided at the combined output of the SMPS modules (if not provided at each SMPS module). All the AC, DC and Control/alarm cabling shall be supplied with the Panel. All DC +ve and –ve leads shall be clearly marked. All conductors shall be properly rated to prevent excessive heating.

8.45. Power Cables

All power cables shall be stranded copper conductor XLPE/PVC insulated and PVC sheathed, single core/two core/three core/four core, 1100V grade as per IS 1554 Part-I.

8.46. Earthing Cables

Earthing cables between equipment and grounding bus bars shall be minimum size 70 mm2 stranded conductors copper/copper strip, rated at 300 volts. All hinged doors shall be earthed through flexible earthing braid. Signal and Safety earthing shall be provided separately.

8.47. Alarms

Following Visual indications/display such as LEDs, LCDs or a combination of both shall be provided to indicate:

a. Functional Indications for local monitoring:
   i. Mains available (not mandatory if provided at module level)
   ii. DCPS/SMPSs in Float
   iii. DCPS/SMPSs in Charge Mode
b. Alarm Indication for local monitoring:
   i. Load Voltage High /Low
   ii. DCPS module/SMPS fail
   iii. Mains out of range
   iv. System Over Load
   v. Mains "ON"/Battery Discharge
   vi. Temp. Compensation fail
   vii. Battery fail/isolated

All the protections/alarms shall be within tolerance of 0.25V in case of DC voltage, 1% in case of DC current and ± 5V for AC voltage

c. Alarm Indication for remote monitoring:
   i. Input AC mains supply fail alarm
   ii. Battery low voltage (Pre cut off) alarm
   iii. DCPS module fail

Potential free Contacts in two numbers for each of the above remote monitoring alarms (one for remote alarm interfaced through RTU and one redundant for local monitoring at suitable location) shall be provided. All these potential free contacts are to be wired and terminated at the suitable location for termination to RTU.

8.48. Temperature Compensation for Battery

There shall be provision for monitoring the temperature of battery and consequent arrangement for Automatic temperature compensation of the SMPS output voltage to match the battery temperature dependant charge characteristics. The output voltage of the rectifier in Float/Charge operation shall decrease or increase at the rate of 72 mV (24 cell battery) per degree increase or decrease in temperature over the set voltage or as may be recommended by the VRLA Battery supplier. The output voltage shall decrease till the open circuit voltage of the battery is reached.

The open circuit voltage range shall be settable between 2.1V/cell to 2.2V/cell. The increase in output voltage due to decrease in temperature has been taken care of by the tripping of the unit due to output voltage high (57V) protection. Failure of temperature compensation circuit including sensors shall create an alarm and shall not lead to abnormal change in output voltage.

8.49. Digital Meters/Display Unit

There shall be provision to monitor the following parameters through digital meters or digital display units:

i. Input AC voltage.
ii. Output DC voltage
iii. Output DC current of charger
iv. Battery current
v. Load current.

The Digital display of meters or display unit shall be with minimum 31/2 digital display of height 12mm and shall have accuracy 1.5% or better.

8.50. Type Testing of DCPS

The contractor shall supply DCPS System, which was already type tested. The test reports for immunity, Emission and surge must be in accordance with relevant IEC/CISPR standards shall be submitted. The Contractor shall submit the DCPS type test reports of earlier conducted tests on the same make, model, type & rating which shall include the following tests. For type testing requirements in addition to provisions of this section 7 is also to be complied.

a. Type Tests on DCPS

1 Surge immunity (Level 4- as per IEC 61000-4-5)

2 Electrical Fast Transients/Burst (Level 4 – as per IEC 61000-4-4)

3 Electrostatic Discharge (Level 4 – as per IEC 61000-4-2)

4 Radiated Electromagnetic Field (Level 3 – as per IEC 61000-4-3)

5 Conducted disturbances induced by radio-frequency field

(Level 3 – as per IEC 61000-4-6)

6 Damped oscillatory magnetic field (Level 3 – as per IEC 61000-4-10)

7 Voltage dips, short interruptions and voltage variations

(Level 2 – as per IEC 61000-4-11)

8 Conducted Emission (Level - Class A, Group 1 as per IEC CISPR 11)

9 Radiated Emission (Level - Class A, Group 1 as per IEC CISPR 11)

10 Verification of Protection class (IP 21) for enclosure

11 Safety Tests (as per IEC 60950)

12 Burn in test for 72 hours at maximum operating temperature

b. Factory/Site Testing of DCPS

The factory/site tests to be carried out on DCPS system/module in the factory and site are listed respectively in Table below. The manufacturer shall conduct routine tests on all the systems/modules and submit the report before offering for FAT. The routine tests shall include atleast the tests mentioned under FAT.

Sl.No.	Test	FAT	SAT
Tests on DCPS System			
1.	Mechanical & Visual Check Tests	√	√

Sl.No.	Test	FAT	SAT
2.	Insulation Test.	√	
3.	High Voltage Withstand Test	√	
4.	Switch On Test	√	√
5.	DCPS Low voltage & High voltage limits check Test	√*	√
6.	Pre-alarm test for Battery Voltage Low	√*	√
7.	Battery Low Voltage Disconnect Level Test	√*	√
8.	AC Input Low and High voltage limits check Test	√*	
9.	Rectifier Fail Alarm Test	√*	√
10.	Voltage Regulation Test	√*	√
11.	Current Sharing Test	√*	
12.	Total Output Power Test	√*	√
13.	Hot Plug In Test	√*	√
14.	Calibration & Parameter settings	√*	√
15.	Automatic Float cum Boost Charge Mode Change Over Test	√*	√
16.	Battery Path Current Limiting Test	√*	√
17.	Battery Charging and full load Current Test	√*	√
18.	Battery Temperature Compensation Test	√*	
19.	Total Harmonic distortion Test	√*	
20.	Burn in Test for 8 hours at max operating temperature	√*	
Tests on SMPS module			
21	Mechanical & Visual Check Test	√*	
22	Module-On Test	√*	
23	Input low/high voltage cut-off test	√*	
24	Voltage Droop Test	√*	
25	Voltage Regulation Test	√*	
26	Power Output & Current Limit Test	√*	
27	DC High Voltage Test	√*	

Sl.No.	Test	FAT	SAT
28	O/P Voltage Ripple Test	√*	
29	Psophometric Noise Test	√*	
30	Efficiency Test	√*	
31	Power Factor	√*	
32.	Input Current Limita	√*	
33.	Input AC Frequency Range Test	√*	
34.	Rectifier Dynamic Response	√*	
35.	Output Short Circuit Test	√*	
36.	Hold up Time Test	√*	

Note* : These tests (Sl. No. 5-36) shall be conducted on 10% samples of the offered batch and other tests (Sl. No 1-4) shall be conducted on each equipment during the FAT.

8.51. BATTERY REQUIREMENTS

The contractor shall supply Valve Regulated Lead Acid (VRLA) maintenance free Battery for UPS & DCPS system. Each battery set shall have sufficient capacity to maintain output at full rated load for duration as defined in BOQ The Bidder shall furnish detailed battery sizing calculations along with all arrangements and supporting structures, for UPS and DCPS system being proposed, along with the bid. In all cases the battery is normally not allowed to discharge beyond 80% of rated capacity (80% DOD) at 10 hours rate of discharge.

The contractor supplying the cells/batteries as per this document shall be responsible to replace/repair free of charge, the battery/cell becoming faulty, owing to defective workmanship or material as per the provisions of the bid document. Battery sizing calculation for UPS shall be done considering the actual charging achieved in eight hours i.e. in case 100% charging is not achieved in eight hours the Ah of the battery shall be enhanced by the ratio of charging actually achieved in eight hours.

8.52. Constructional Requirements

The design of battery shall be as per field proven practices. Partial plating of cells is not permitted. Paralleling of cells externally for enhancement of capacity is not permitted. Protective transparent front covers with each module shall be provided to prevent accidental contact with live module/electrical connections. It shall be possible to easily replace any cell of the battery at site in normal working condition.

a. Containers

The container material shall have chemical and electro-chemical compatibility and shall be acid resistant. The material shall meet all the requirements of VRLA batteries and be consistent with the life of battery. The container shall be fire retardant and shall have an Oxygen Index of at least 28%. The porosity of the container shall be such that so as not to allow any gases to escape except from the regulation valve. The tensile strength of the material of the container shall be such that so as to handle the internal cell pressure of the cells in the worst working condition.

Cell shall not show any deformity or bulge on the sides under all working conditions. The container shall be capable of withstanding the rigours of transport, storage and handling. The containers shall be enclosed in a steel tray.

b. Cell Covers

The cell covers shall be made of suitable material compatible with the container material and permanently fixed with the container. It shall be capable to withstand internal pressure without bulging or cracking. It shall also be fire retardant. Fixing of Pressure Regulation Valve & terminal posts in the cover shall be such that the seepage of electrolyte, gas escapes and entry of electro-static spark are prevented.

c. Separators

The separators used in manufacturing of battery cells, shall be of glass mat or synthetic material having high acid absorption capability, resistant to sulphuric acid and good insulating properties. The design of separators shall ensure that there is no misalignment during normal operation and handling.

d. Pressure Regulation Valve

Each cell shall be provided with a pressure regulation valve. The valve shall be self re-seal able and flame retardant. The valve unit shall be such that it cannot be opened without a proper tool. The valve shall be capable to withstand the internal cell pressure specified by the manufacturer.

e. Terminal Posts

Both the +ve and –ve terminals of the cells shall be capable of proper termination and shall ensure its consistency with the life of the battery. The surface of the terminal post extending above the cell cover including bolt hole shall be coated with an acid resistant and corrosion retarding material. Terminal posts or any other metal part which is in contact with the electrolyte shall be made of the same alloy as that of the plates or of a proven material that does not have any harmful effect on cell performance. Both +ve and –ve posts shall be clearly and unambiguously identifiable.

f. Connectors, Nuts & Bolts, Heat Shrinkable Sleeves

Where it is not possible to bolt the cell terminals directly to assemble a battery, separate non-corroding lead or copper connectors of suitable size shall be provided to enable connection of the cells. Copper connections shall be suitably lead coated to withstand corrosion due to sulphuric acid at a very high rate of charge or discharge.

Nuts and bolts for connecting the cells shall be made of copper, brass or stainless steel. Copper or brass nuts and bolts shall be effectively lead coated to prevent corrosion. Stainless steel bolts and nuts can be used without lead coating.

All inter cell connectors shall be protected with heat shrinkable silicon sleeves for reducing the environmental impact including a corrosive environment.

g. Flame Arrestors

Each cell shall be equipped with a Flame Arrestor to defuse the Hydrogen gas escaped during charge and discharge. Material of the flame arrestor shall not affect the performance of the cell.

h. Battery Bank Stand

All batteries shall be mounted in a suitable metallic stand/frame. The frame shall be properly painted with the acid resistant paint. The suitable insulation shall be provided between stand/frame and floor to avoid the grounding of the frame/stand.

8.53. Capacity Requirements

When the battery is discharged at 10-hour rate, it shall deliver 80% of C (rated capacity, corrected at 27ºCelcius) before any of the cells in the battery bank reaches 1.85V/cell.

All the cells in a battery shall be designed for continuous float operation at the specified float voltage throughout the life. Float voltage of each cell in the string shall be within the average float voltage/cell +0.05V band.

The capacity (corrected at 27ºCelcius) shall also not be less than C and not more than 120% of C before any cell in the battery bank reaches 1.75V/cell. The battery voltage shall not be less than the following values, when a fully charged battery is put to discharge at C/10 rate:

(a) After Six minutes of discharge : 1.98V/cell

(b) After Six hours of discharge : 1.92V/cell

(c) After 8 hours of discharge : 1.85V/cell

(d) After 10 hours of discharge : 1.75V/cell

Loss in capacity during storage at an average ambient temperature of 35º Celsius for a period of 6 months shall not be more than 60% and the cell/battery shall achieve 85% of its rated capacity within 3 charge/discharge cycles and full rated capacity within 5 cycles, after the storage period of 6 months. Voltage of each cell in the battery set shall be within 0.05V of the average voltage throughout the storage period. Ampere-hour efficiency shall be better than 90% and watt-hour efficiency shall be better than 80%.

8.54. Expected Battery Life

The battery shall be capable of giving more than 1200 charge/discharge cycles at 80% Depth of discharge (DOD) at an average temperature of 27º Celsius. DOD (Depth of Discharge) is defined as the ratio of the quantity of electricity (in Ampere-hour) removed from a cell or battery on discharge to its rated capacity. The battery sets shall have a minimum expected operational life of 5 years at normal operating conditions or 1200 charge / discharge cycles (whichever is early).

8.55. Routine Maintenance of Battery system

For routine maintenance of battery system, the contractor shall supply 1 set of following tools:

a. Torque wrench.
b. Tool for opening /closing of pressure regulation valve of battery.
c. Hand held digital Multimeter for measurement of resistance, AC/DC voltages.

8.56. Testing of Battery

The contractor shall supply type tested battery as required for DCPS and UPS system. The Contractor shall submit the Battery type test reports of earlier conducted tests on the same make, model, type & rating as offered as per the IEC 60896 or equivalent IS/EN/BS standards. These Type test reports shall be submitted for the highest rating battery to be supplied under the contract. For type testing requirements in addition to provisions of this section 7 is also to be complied. The tests mentioned in the Table 4.2 shall be conducted on the battery at site and factory.

TABLE 4.2 LIST OF FACTORY & SITE TESTS FOR BATTERY

S. No.	Test	Factory Tests	Site Tests
1.	Physical Verification	√	√
2.	C/10 Capacity test on the cell	√	
3.	8 Hrs. Charge and 30 minutes (duration as specified) discharge test at full rated load for UPS.		√

8.57. Testing Requirements

The requirements for type tests, factory acceptance tests and field acceptance testing have been specified under the respective clauses. After completion of field acceptance testing the auxiliary power supply system shall be put under availability test for fifteen (15) days. Availability test shall be carried out by the employer/owner. During the availability test the APS shall be used as required to be used for rest of the life. In case of any failure or mal-operation during this period the contractor shall take all necessary action to rectify the problems. The APS shall be accepted only after rectification of the problems by the contractor in a manner acceptable to the employer.

8.58. 2KVA UPS

Two KVA UPS shall be supplied for bill collection centres as per the quantity specified in the BOQ. The technical particulars of these UPS shall be as mentioned below:

Technical Specification for 2 KVA (1.6 KW) UPS

	Parameter	Requirements
INPUT	Voltage	230±15%V AC, 50Hz, Single phase
	Frequency	50 ± 5% Hz
OUTPUT	Power	2 kVA / 1.6 kW (at 0.8 pf)
	Voltage	230V AC Single phase (±1 %)
	Frequency	50 Hz & ±0.2%(Free Running)
	Regulation	±1%
	Transient Response	±5% for 100% load change and recovers to normal within 10 milliseconds
	Waveform	Pure Sine wave, THD <2% (linear load)
	Short term overload	110% for 15 minutes and 150% for 10 seconds
	Efficiency (Peak)	>90%

	Parameter	Requirements
	Supported load pf	0.6-unity
	Change Over	Transfer time (in Sync Mode) less than 5 msec
BATTERY	Type	SMF/lead Acid tubular
	Backup time	4 hours
	Recharge Time	Maximum12 hours*
	Life	Minimum 3 years (SMF)/ 8 years(LATB)
GENERAL	LED Indicators	Mains ON, Converter / Inverter faults, O/P high/low, Bypass mode, Inverter ON/OFF
	Audible Alarm	Main Failure, Low Battery, Overload
	Isolation	UPS output isolated from Mains Input
	Protection class	IP-21
	Temperature	0-45º C (Battery shall be sized at an average temp. of 27 deg C.)
	Humidity	Upto95% RH (Non condensing)

* Note: Battery shall be sized to deliver rated load for specified duration after charging for 12 hours from fully discharged state of battery(1.75V for VRLA).

8.59. Documentation

The following specific document for items covered under this section shall be submitted which shall be in addition to the applicable general document required under section 7.

a. Data Requirement Sheets (DRS)
b. Battery sizing calculations
c. Cable sizing calculations
d. Inventory of the hardware
e. Panel General arrangement drawing
f. Panel Internal General Arrangement drawing indicating modules, major devices/components location etc.
g. Installation drawings
h. Schematic drawings
i. Type Test reports
j. FAT plan & procedure
k. SAT plan & procedure
l. External cable laying & termination schedule details

Availability test plan & procedure

C. IT COMPONENT

1. Field Offices Networking:

Wall Mount Rack for Field Office				
Sl. No.	**Parameter**	**Specification**	**Supplier Response(Compliant/Not Compliant**	**Remarks**
1	Rack Details	6U wall moun track with MinimumSupports100 Kg, Locking front door, Multiple Doors: Vented, Glass, Solid, Reversible Door to Left or Right Side, Removable side panels for ease of use, Top vent for4.5"fan,Min.2 cables lots in top and bottom, 20"Min. mounting depth for networking equipment with complete load taking capability for the networking as proposed.		
2	Construction	6U/600MMDX550MMW1 SECN with front glass door camlock (Powder coated)		
3	Accessories.	Adequate no of Cables and accessories like cable ties, cable guides, stabilizer kit. Door branding kit, screws and ballast kit as required need to be proposed with each rack. Additionally bidders are requested to offer additional if any required for the solution.		
4		shelf255mx 1		
5		19” 1U cable manager x 1		
		FAN90CFM x 1		
7		Power Strip 6 Pts.(5AMP)		
UTP Cable				
1	**Parameter**	**Specification**		
2	Type	CAT6		
3	Grade	4 Pair23 AWG Solid Copper Conductors withFR Grade		
4	Frequency	Characterised to 600Mhz		
5	Compliance &Certification	ETL Certified, ANSI/TIA-568-C.2,ISO/IEC11801 and EN50173-1 Cat6		
6	Performance	Zero Bit Error Performance Testing by ETL		
7	Jacket	Fire Retardant PVC		
8	Separator	Incorporates central X-shaped polymerspinemaintaining4 pairs separation.		

Wall Mount Rack for Field Office				
Sl. No.	**Parameter**	**Specification**	**Supplier Response(Compliant/Not Compliant**	**Remarks**
9	Pull/Strip Thread	Should have Cable Pull Tension Thread inside the UTP Cable		
10	Mechanical Characteristics	Conductor: Solid Bare Copper, AWG:23,ConductorDia Norm:0.574, Insulation: PE, Average Thickness (±0.03mm):0.23, Min. Point Thickness (mm):0.18, Insulation Dia.(±0.05mm):1.04,Twisting Lay Length (mm):30underneath, Cabling Lay Length (±10mm):140, Filler: PE, Average Thickness (±0.05mm):0.50, Min. Point Thickness(mm):0.46, Outer Dia.		
11	Certification	UL Listed and ROHS Compliant		
12	Rating	CM -For Horizontal Cabling		
13	Meter Marking	Printed with every Feet Lengths of the UTP Cable		
UTP Patch Panel				
1	Jack Connector	Plastic Housing: Polycarbonate, UL94V-0 rated or equivalent, Operating Life: Minimum750 insertion cycles, Contact Material: Copper Alloy, Contact Plating: 50µ" Gold/100µ" Nickel, Contact Force: 100g minimum, Plug Retention Force:15lb., Operating Life: Minimum 200 re terminations, IDC Contact Plating: Tin/Lead Plate, Wire Accommodation:22-24 AWG solid		
2	RJ45 I/O Compatibility	Individual Compatible RJ45Jack, Pointed IDC Tower on RJ45 Jack for easy termination, Half Plugged Patch Cord should be spitted out if not properly plugged in		
3	Material	CRS-Cold Rolled Steel(Thickness-1.5mm)with ROHS Compliant		
4	Dust Proof	Each port features the patented spring-loaded shutter to prevent incomplete mating and protection from dust and contaminants		
5	Dimension	44mmHx 483mmW x 98mmD		

Wall Mount Rack for Field Office				
Sl. No.	**Parameter**	**Specification**	**Supplier Response(Compliant/Not Compliant**	**Remarks**
6	Rear Cable Manager	Flat type metal with Perforated Rear Cable Manager to hold CAT6 UTP Cable with velcro cable ties		
7	Labels	Should include labels with transparent clear label covers at the front and Port number at the back. 4 x 6 ganged jack configuration		
8	Commercial Standards:	TIA/EIA-568-B.2-1 Component Compliant, FCC Sub part F 68.5 Compliant, IEC-603-7Compliant, ISO11801 Class E Compliant, ETL Verified for Category 6 Component Compliance		
9	OEM Criteria	All Passive materials (Cat6UTP items) Should be of same make. The OEM should be ISO9001 &14001 Certified. Copy of ISO Certificates need to submit with BID. Accepted brands are Molex, Systimax, and Panduit.		
10		CAT6 UTP components should have independent lab verification like ETL certificates. The cabling should be certified to have applicationsupportwarrantyfornext25 years		
UTP Patch Cord(1/2/3 Meters)				
1	Mechanical Characteristics-Cable	Conductor size: 24 AWG stranded copper wire, Nom. O.D.: 5.9mm, Sheath: LS0H, Bend radius: 4XO.D., Operating temperature range:-20°Cto 60°C		
2	Mechanical Characteristics-Plug	MIN operating life: 750 insertion cycles, RJ45plugand boot material: Clear polycarbonate, Contact material: 0.35mm thick copper alloy, Contact plating: Selective gold, RJ45 plug dimensions compliant with: ISO/IEC60603-7-4 andFCC47 Part68		
3	Electrical Characteristics	Max voltage:150 V AC(max), Max current:1.5A@25°C		
4	Boots	Transparent Plug with anti-snag slip on boots		
5	Sheath Standards	LS0HSheath:CSAFT1, IEC60332-1,IEC61034		

Wall Mount Rack for Field Office				
Sl. No.	**Parameter**	**Specification**	**Supplier Response(Compliant/Not Compliant**	**Remarks**
6	Separator	Cross/Star Spine to separate 4Pairs Patch Cords		
7	Standards	ETL Certified with ANSI/TIA-568-C.2,ISO/IEC11801 Category6		
8	Operating Temp	-20 Degrees to+60 Degrees		
UTPI/O				
1	Type	Cat6 grade jack is designed to maintain clean secure connections. RJ-45jack shall have' spring-loaded shutter' to protect from dust and contaminants as well as provides tactile feedback(spring-loaded shutter pops out an improperly seated patchcord–all with single-handedplug-in and removal)		
2	Wire terminal	200 termination cycles		
3	Modular Jack	750 mating cycles		
4	Plastic Housing	Polycarbonate, UL94V-0 rated or equivalent		
5	IDC Contact Plating	Tin/Lead Plate		
6	Dust Proof	Spring-loaded shutter in Jack(No Shutter in Face Plate) to prevent incomplete mating and to protect from dust and contaminants		
7	ROHS/ELV	ROHS Compliant		
8	Commercial Standards:	TIA/EIA-568-C.2 Component Compliant, FCC Sub part F 68.5 Compliant, IEC-603-7Compliant, ISO11801 Class E Compliant, ETL Verified forCategory6 Component Compliance& UL listed		
Face Plate				
1	Face Plate	Dimension:86 x 86mm. Colour of the Jack should be visible to identify the application of Data,Voice and Redundant Port		
2	Colour	White		
3	Grade	Fire Retardant		
4	Construction	PS /ABS Rugged plastic with ROHS Compliant		

Wall Mount Rack for Field Office				
Sl. No.	**Parameter**	**Specification**	**Supplier Response(Compliant/Not Compliant**	**Remarks**
5	Jack Support	Support for UTP Jack, STP Jack, Fiber Coupler& Coax Connector.		
6	Back Box	Back Box should be supplied as per Face plate		

2. Load Balancer:

Sl. No.	**Specification**	**Supplier Response(Compliant/ Not Compliant**	**Remarks**
	Load Balancer		
	Hardware for Network Functions Consolidation(NFC)		
1	It should be high performance purpose built next generation multi-tenant hardware with multi-core CPU support. Platform should support multiple network functions including application load balancing, application firewall, SSL intercept, secure remote access using SSL, global server load balancing and3rdparty network functions with dedicated hardware resources for each network function.		
2	Guaranteed performance–dedicated hardware resources including vCPU's, I/O, memory, SSL card, per virtual function ,SR-IOV (Single Root–I/O Virtualization), open v Switch		
3	REST-API/Cloud API support for integration with centralized orchestration, cloud platform, and elasticity		
4	Platform should have option to support 3rd party network functions from day one		
5	The platform must support SDK for IOT		
6	The appliance should support minimum 1*SSLASIC /FGPA/cards with network virtual function support		

Sl. No.	Specification	Supplier Response(Compliant/ Not Compliant	Remarks
7	Next generation multi-tenant platform must support traffic isolation, fault isolation and network isolation in order to meet the architectural environment. Each network function must have assigned dedicated hardware resources including I/O interfaces, memory, CPU, SSL card in order to ensure every network functions performs without affecting other functions		
8	Should provide secure online application delivery using hardware-based high performance integrated SSL acceleration hardware. SSL hardware should support both 2048 and 4096 bit keys for encrypted application access.		
9	Should provide comprehensive and reliable support for high availability both at device level and Virtual function level		
10	Device level HA should support synchronization of network functions configuration from primary/master device to secondary/slave device		
11	Platform should support multiple network functions in order to cater current and future requirements and performance numbers including throughput, connections, SSL throughput and SSL transactions. The platform must have below configuration to support multiple network functions.		
12	• Minimum Network Function - 8 • Minimum system throughput – 35 Gbps • Connection per second – 650K • L4 Concurrent Connections - 8M • Minimum Data interfaces – 4x 10G SFP+ • Minimum Memory - 64 GB • Minimum SSL TPS (2K Key) - 12K • Minimum SSL Throughput – 10 Gbps		

Sl. No.	Specification	Supplier Response(Compliant/ Not Compliant	Remarks
13	MSI should design solution such a way that most of network functions should be consolidated in this platform to save power, cooling and space in the data centre. The platform must consolidate network functions like Application load balancer, SSL Offload, reverse proxy, WAF, SSL-I and secure access gateway.		
	Application Load Balancer Virtual Appliance		
14	It should able to load balancer both TCP and UDP based applications with layer 2 to layer 7 load balancing support		
15	The appliance should support server load balancing algorithms i.e. round robin, weighted round robin, least connection, Persistent IP, Hash IP, Hash Cookie, consistent hash IP, shortest response, proximity, SNMP, SIP session ID, hash header etc		
16	Support for policy nesting at layer7 and layer4, solution should able to combine layer4 and layer7 policies to address the complex application integration.		
17	Script based functions support for content inspection, traffic matching and monitoring of HTTP, SOAP, XML, diameter, generic TCP, TCPS. Load balancer should support e-Policies to customize new features in addition to existing feature/functions of load balancer		
18	Traffic load balancing using e-Policies should support algorithms including round robin, least connections, shortest response, persistence ip, hash ip, hash ip and port, consistent hash IP and SNMP		
19	Should provide application & server health checks for well-known protocols such as ARP, ICMP, TCP, DNS, RADIUS, HTTP/HTTPS, RTSP etc.		
20	Appliance should provide real time Dynamic Web Content Compression to reduce server load and solution should provide selective compression for Text, HTML, XML, DOC, Java Scripts, CSS, PDF, PPT, and XLS Mime types		
21	should provide advanced high performance memory/packet based reverse proxy Web cache; fully compliant with HTTP1.1 to enhance the speed and performance of web servers		

Sl. No.	Specification	Supplier Response(Compliant/ Not Compliant	Remarks
22	Shouldprovidesupportforcacherules/filterstodefinegranularcachepoliciesbasedoncache-controlheaders, hostname, file type, max object size, TTL objects etc..		
23	ADC network function should support built in fail over decision/health check conditions (both hardware and software based) including CPU over heated, SSL card, port health, CPU utilization, system memory, process health check and gateway health check to support the fail over in complex application environment		
24	ADC network function Should have option to define customized rules for gateway health check – administrator should able to define a rule to inspect the status of the link between the unit and a gateway		
25	ADC network function Support for automated configuration synchronization support at boot time and during runtime to keep consistence configuration on both units		
26	This Network function should run seamlessly on NFC hardware		
27	Proposed solution should support remote access which is 100%client less for web based applications.		
28	It should support SSL acceleration, compression and SSL VPN remote access		
29	Must support for CIFS file share and provision to browse, create and delete the directories through web browser		
30	Should maintain original server access control policies while accessing the file resources through VPN		
31	Must support Single Sign-On (SSO) for web based applications and web based file server access		
32	Should have secure access solutions for mobile PDAs, Android smartphones, ipad, iphones		
33	Should SupportIPV6		
34	Proposed solution must provide machine authentication based on combination of HDD ID, CPU info and OS related parameters i.e. MAC address to provide secure access to corporate resources		

Sl. No.	Specification	Supplier Response(Compliant/ Not Compliant	Remarks
35	Should support following Authentication methods: - LDAP, Active directory, Radius, secure ID, local database, and certificate based authentication and anonymous access.		
36	This Network function should run seamlessly on NFC hardware		
	Virtual Appliance for SSL of load and reverse proxy		
37	The appliance should support Certificate format as "Open SSL/Apache, *.PEM", "MS IIS, *.PFX", and" Netscape, *.DB".		
38	The appliance should have additional hardware card to perform the SSL offloading/acceleration for1024 and2048 bit certificates.		
39	The appliance should support use of password protect Certificate/Private Key backup/restore to/from local disk or remote TFTP server, and through Web UI		
40	The appliance should support Self generates CSR (Certificate Signing Request), self-signed Certificate and private key for specified host.		
41	The appliance should support customization for SSL Error pages.		
42	The appliance should support HTTP to HTTPS location header rewrite for enhanced application delivery support		
43	The appliance should have end to end ssl support to act as a SSL Server and/or as SSL Client		
44	Should support client certificate verification, certificate bases access control, CRL's (HTTP, FTP ,LDAP) and OSCP protocol		
45	Should support one arm, reverse and transparent proxy mode deployment scenarios and should support nested layer7 and l4policies.		
46	should have security features like reverse proxy firewall, Syn-flood and dos attack protection features from the day of installation .		
47	This Network function should run seamlessly on NFC hardware		

Sl. No.	Specification	Supplier Response(Compliant/ Not Compliant	Remarks
	Virtual Appliance for Link Load Balancer		
48	Support for multiple internet links in Active-Active load balancing and active-standby fail over mode.		
49	Should support Outbound load balancing algorithms like round robin, Weighted round robin, shortest response, target proximity and dynamic detect		
50	Should support in bound load balancing algorithms like round robin, Weighted round robin, target proximity & dynamic detect.		
51	Should support Static NAT, Port based NAT and advanced NAT for transparent use of multiple WAN/ Internet links.		
52	IPV6 support with IPv6 to IP4 and IPv4 toIPv6translation and full IPv6 support.		
53	In case of link failure, device should detect it in less than30 seconds and divert the traffic to other available links.		
54	Shall provide individual link health check based on physical port, ICMP Protocols, user defined l4portsand destination path health checks.		
55	Should provide mechanism to bind multiple health checks, support for Application specific VIP health check and next gateway health checks.		
56	Should support persistency features including RTS (return to sender) and ip flow persistence.		
57	This Network function should run seamlessly on NFC hardware		

Firewall:

Sl. No.	Specification	Supplier Response (Compliant/ Not Compliant	Remarks
	Firewall		
	General Requirements		

Sl. No.	Specification	Supplier Response (Compliant/ Not Compliant	Remarks
1	Network security appliance should support "Stateful" policy inspection technology. It should also have application intelligence for commonly used TCP/IP protocols like telnet, ftpetc.		
2	The proposed vendor must have a track record of continuous improvement in threat detection (IPS)and must have successfully completed NSS Labs' NGFW Methodology v7.0 testing with a minimum exploit blocking rate of99%		
3	OEM should be in Leaders quadrant of Gartner's–in Enterprise Firewall Magic Quadrant as per the latest report		
4	Appliance shall be ICSA certified for Firewall, IPS & Gateway Anti Virus functionalities		
	Hardware & Interface requirements		
1	Minimum8 x 1GE RJ45inbuiltinterfaces, 8 x1GE SFPinterfaceand2x 10GE SFP+ interface slots from day one		
2	The Appliance should have USB& Console Ports and dedicated HA ports in addition to requested data ports		
	Performance and Availability		
1	The Firewall should be on multi process or architecture with minimum support of 7,500,000 concurrent sessions, and 300,000 new sessions per second from day one and Firewall Latency should not be more than 3µs		
2	Minimum IPS throughputof5000Mbpsfor real world traffic or enterprise mix traffic		
3	Minimum Threat Prevention Throughput (measured with Application Control and IPS and Anti-Malware enabled) of 5000 Mbps for real world traffic or enterprise mix traffic		
4	IPSec VPN throughput: minimum20 Gbps		
5	Application control throughput–14Gbps(64KHTTP)		
6	Proposed solution must support minimum 6.5 Gbps of SSL Inspection throughput		
7	Proposed solution must support minimum 10 virtual firewall from day one		
	Routing Protocols		

Sl. No.	Specification	Supplier Response (Compliant/ Not Compliant	Remarks
1	Static Routing		
2	Policy Based Routing		
3	The Firewall should support dynamic routing protocol like RIP, OSPF, BGP,ISIS		
	Firewall Features		
1	Firewall should provide application inspection for LDAP, SIP, H.323, SNMP, FTP,SMTP, HTTP, DNS, ICMP, DHCP, RPC,SNMP, IMAP, NFS etc		
2	IPv6-enabled inspection services for applications based on HTTP, FTP, SMTP, ICMP,TCP, and UDP		
3	Allows secure deployment of next-generation IPv6 networks, as well as hybrid environments that require simultaneous, dual stack support of IPv4 and IPv6		
4	The firewall should support transparent (Layer2) firewall or routed (Layer3) firewall Operation		
5	The Firewall should support ISP link load balancing.		
6	Firewall should support link aggregation functionality to group multiple ports as single port.		
7	Firewall should support minimum VLANS 2048		
8	Firewall should support static NAT, policy based NAT and PAT		
9	Firewall should support IPSec data encryption		
10	It should support the IPSec VPN for both site-site and remote access VPN		
11	Firewall should support IPSec NAT traversal.		
12	Support for standard access lists and extended access lists to provide supervision & control		
13	Control SNMP access through the use of SNMP and MD5 authentication.		
14	Firewall system should support virtual tunnel interfaces to provision route-based IPSec VPN		
15	The Firewall should have integrated solution for SSL VPN		
16	Should support LDAP, RADIUS, Windows AD, PKI based Authentication & should have integrated 2-Factor Authentication server support & this two factor authentication can be used for VPN users for accessing internal network from outside and for Local users accessing internet from inside the network and for administrative access to the appliance or all of them		

Sl. No.	Specification	Supplier Response (Compliant/ Not Compliant	Remarks
17	The solution should have basic server load balancing functionality as an in built feature		
18	Licensing should be a per device and not user or IP based (should support unlimited users)		
	Integrated IPS Features Set		
1	IPS should have DDoS and DoS anomaly detection and protection mechanism with threshold configuration.		
2	Support SYN detection and protection for both targets and IPS devices.		
3	The device shall allow administrators to create Custom IPS signatures		
4	Should have a built-in Signature and Anomaly based IPS engine on the same unit		
5	Signature based detection using real time updated database & should have minimum10000+ IPS signature database from day one		
6	Supports automatic security updates directly over the internet. (ie no dependency of any intermediate device)		
7	Signature updates do not require reboot of the unit.		
8	Configurable IPS filters to selectively implement signatures based on severity, target (client/server) and operating systems		
9	IPS Actions :Default, monitor, block, reset, or quarantine		
10	Should support packet capture option		
11	IP(s)exemption from specified IPS signatures		
12	Should support IDS sniffer mode		
	Anti Virus & Anti Bot		
1	Firewall should support antimalware capabilities ,including antivirus, botnet traffic filter and antispyware		
2	Solution should be able to detect and prevent unique communication patterns used by BOTs i.e. information about botnet family		
3	Solution should be able to block traffic between infected host and remote operator and not to legitimate destination		
4	Should have anti virus protection for protocols like HTTP, HTTPS, IMAPS, POP3S, SMTPS protocols etc.		

Sl. No.	Specification	Supplier Response (Compliant/ Not Compliant	Remarks
5	Solution should have an option of packet capture for further analysis of the incident		
6	Solution should uncover threats hidden in SSL links and communications		
7	The AV should scan files that are passing on CIFS protocol		
8	The proposed system shall provide ability to allow, block attachments or downloads according to file extensions and/or file types		
9	The proposed system should be able to block or allow oversize file based on configurable thresholds for each protocol types and per firewall policy.		
	Other support		
1	Should support features like Web-Filtering, Application-Control & Gateway level DLP from day one		
2	The proposed system should have integrated Enterprise-class Web Content Filtering solution with database which should supportover250 million webpages in 72+ categories and 68+ languages without external solution, devices or hardware modules.		
3	Should support detection over3,000+ applications in multiple Categories: Botnet, Collaboration, Email, File Sharing, Game, General Interest, Network Service, P2P, Proxy, Remote Access, Social Media, Storage Backup, Update, Video/Audio, VoIP, Industrial, Special, Web (Others)		
4	TheproductmustsupportsLayer-7 based UTM/Firewall virtualization, and all UTM features should be supported in each virtual firewall like Threat Prevention, IPS, Web filter, Application Control, content filtering etc.		
5	The solution should have the flexibility to write security policies based on IP Address & User Name & Endpoint Operating System		
6	QoS features like traffic prioritization, differentiated services,. Should support for QoS features for defining the QoS policies.		

Sl. No.	Specification	Supplier Response (Compliant/ Not Compliant	Remarks
7	It should support the VOIP traffic filtering		
8	Appliances should have identity awareness capabilities		
9	The firewall must support Active-Active as well as Active-Passive redundancy.		
10	Solution must support VRRP clustering protocol.		
	Management& Reporting functionality		
1	Support for Built-in Management Software for simple, secure remote management of the security appliances through integrated, Web-based GUI.		
2	Support accessible through variety of methods, including console port, Telnet, and SSHv2		
3	Support for both SNMPv2and SNMPv2c, providing in-depth visibility into the status of appliances.		
4	Should have capability to import configuration and software files for rapid provisioning and deployment using Trivial File Transfer Protocol (TFTP),HTTP, HTTPS		
5	The solution should have option for firewall configuration audit & compliance check to be done in automated or manual process		
6	Should capable to provide a convenient method for alerting administrators when critical events are encountered, by sending e-mail alert messages to administrator defined e-mail addresses		
7	Solution must allow administrator to choose to login in read only or read-write mode		

3. EMS/NMS:

Sl. No.	Specification	Supplier Response (Compliant/ Not Compliant	Remarks
	EMS		
	General Requirements		
1	The Monitoring Solution should provide Unified Architectural design offering seamless common functions including but not limited to:		

Sl. No.	Specification	Supplier Response (Compliant/ Not Compliant	Remarks
	a)Event and Alarm management,		
	b)Auto-discovery of the IT environment,		
	c)Performance and availability management		
	d)Correlation and root cause analysis		
	e)Service Level Management, notifications		
	f)Reporting and analytics		
	g)Automation and Customization		
2	There should be a tight integration between infrastructure metrics and logs to have the single consolidated console of Infrastructure & security events.		
3	Consolidate IT event management activities into a single operations bridge that allows operator quicklyi dentify the cause of the IT incident, reduces duplication of effort and decreases the time it takes to rectify IT issues.		
4	The Operator should be able to pullup security events related to a given Configuration Item, from a single console which also has NOC events, and use the security events to triage the problem. This way the Operator gets consolidated system/network event details and security events (current and historical) from the same console and save time in troubleshooting/isolating the issue.		
5	The operator should be able to build correlation rules in a simple GUI based environment where the Operator should be able to correlate cross domain events		
6	Proposed EMS/NMS solution MUST have atleast3 deployments in Indian Government/ Public Sector, monitoring & managing 10,000+ network nodes in each of such deployments. Names must be mentioned at the time of bidding.		
7	Proposed EMS/NMS solution must be ISO27001 certified to ensure security compliances		
8	Proposed EMS/NMS solution must be an industry standard, enterprise grade solution recognized by leading analysts		
9	Proposed EMS/NMS solution must be among the top 10 market share vendors globally. Substantiate with the relevant document/ report.		
10	Proposed Helpdesk must be ITIL Gold-level certified on atleast10+processes.		
11	Probable OEM should have their RnD group based out in India.		

Sl. No.	Specification	Supplier Response (Compliant/ Not Compliant	Remarks
12	Probable OEM technical support group should be based in different countries covering multiple time zones including India.		
13	Probable OEM should have their sales and implementation services running with-in the same origination.		
14	Scalability– The system should be capable of supporting at least 100thousand network flow per second on single server with capability to capture each unique traffic conversations		
15	Scalability– The solution must be scalable, it should be able to support upto 25000 log events per second and also be able to support beyond 25000 EPS by linearly adding more servers of either reference system type, depending on the size of the expected load.		
16	The solution shall provide future scalability of the whole system without major architectural changes.		
17	The Solution shall be distributed, scalable, and multi-platform and open to third party integration such as Cloud, Virtualization, Database, Web Server, Application Server platforms etc.		
18	All the required modules should be from same OEM and should be tightly integrated for single pane of glass view of enterprise monitoring		
19	The solution must provide single integrated dashboard to provide line of business views and drilldown capabilities to navigate technical operators right from services to last infrastructure components		
20	Consolidated dashboard of the proposed EMS solution mus tbe able to do dynamic service modelling of all business critical production services & use near-real time Service Model for efficient cross domain topology based event correlation.		
	Centralized and Unified Dashboard		
21	Tool should provide superior view of infrastructure health across system, networks, databases and IT infrastructure into a consolidated, central console.		
22	The solution should support dynamic discovery to maintains Run-time Service Model accuracy e.g. virtualization and cloud.		
23	Powerful correlation capabilities to reduce number of actionable events. Topology based and event stream based correlation should be made available.		

Sl. No.	Specification	Supplier Response (Compliant/ Not Compliant	Remarks
24	The solution must support custom dashboards for different role users such as Management, admin and report users.		
25	The solution should provide superior view of infrastructure health across system, networks, application and other IT Infrastructure components into a consolidated, central console.		
26	The solution should allow for customizable operator perspectives.		
27	Integrated UI workflows, mash-up GUI, one dashboard, common KPIs, single event subsystem		
	Server Fault & Performance Monitoring		
28	Should offer service driven operations management of the IT environment to manage distributed, heterogeneous systems-Windows, UNIX & LINUX from a single management station.		
29	Should provide a centralized point of control with out-of-the-box policy-based management intelligence for easy deployment for the servers, operating systems, applications and services for correlating and managing all the IT infrastructure components of a business service		
30	The System Should have automated service discovery, policy deployment and actions to enable busy IT personnel to focus on more strategic initiatives and manage business-critical application services from the end-user perspective, and to be immediately aware of the business impact of lower level component failures or performance degradations		
31	Highly scalable, and can manage in excessof1000 managed nodes from a single server with ability push deployment of agents and monitoring policies to a variety of heterogeneous platforms enabling fast and controlled rollout and maintenance		
32	Should support Virtual platforms-VMware and Microsoft Virtual Server, Citrix and provide capability to manage both Microsoft.NETandJ2EEapplicationsfromthe same platform.		
33	Alarms with meaningful message text, instruction text, operator/automatic actions/linked graphs, duplicate message suppression.		
34	Agents on the managed node should be autonomous and can undertake automated corrective actions in isolation from the Management server. This will provide management by exception for only forwarding actionable events to the Management server.		

Sl. No.	Specification	Supplier Response (Compliant/ Not Compliant	Remarks
35	The system must include very powerful event management and correlation services technology, providing correlation capabilities on the agents in addition to the central manager station to filter, correlate, process, and respond to the thousands of events that are created daily from systems, databases, and applications.		
36	The solution should be able to project near real time business and IT KPI data in one single dashboard and should be able to incorporate weather feeds for forecasting purpose for all devices(VM, Cloud, Network, DB, Server, etc.).		
37	The solution should have inbuild robotic based collaboration to reduce human overhead and allowing agent to focus in productive task for all the EMS tools.		
	Network Fault Management		
39	The solution should allow for Spiral discovery to be run on a continuous basis which tracks dynamic changes near real-time; in order to keep the topology always up to date. This discovery should run at a low overhead, incrementally discovering devices and interfaces.		
40	Polling intervals should be configurable on a need basis through a GUI tool, to ensure that key systems are monitored as frequently as necessary.		
41	The NMS must allow immediately determining the impact of a component failure and thus helping in prioritizing problem-solving efforts.		
42	NMS should have support for SNMPv3 & IPv6, includingdual-stackIPv4 &IPv6 to provide flexibility in protocol strategy and implementation and should have MIB browsing, MIB loading, and MIB expression collection features.		
43	The system should support a variety of discovery protocols. The system should take advantage of available information to aid in discovery of the network. Protocols should include ARP, DNS, SNMP, BGP, EIGRP, OSPF, CDP (Cisco), EDP(Extreme), NDP (SONMP-Nortel),FDP (Foundry), EnDP (Enterasys),and LLDP(link-level discovery protocol).		
44	The topology of the entire Network should be available in a single map along with a Network state poll with aggressive/customizable polling intervals		

Sl. No.	Specification	Supplier Response (Compliant/ Not Compliant	Remarks
45	The NMS must allow immediately determining the impact of a component failure and thus helping in prioritizing problem-solving efforts.		
46	The proposed system must be capable of providing the following detailed analysis across surveillance domain:		
	a)Top utilized links (inbound and outbound)based on utilization of link		
	b)Top protocols by volume based on utilization of link		
	c)Top host by volume based on utilization of link		
47	It should be able to correlate multiple occurrences of a specific fault on a device within a specified time frame to enable detection of chronic problems. At any given point in time there may not exist a fault for a chronic issue, but we need to know that the condition continues to happen. For example: Circuit down20 times inlast24hour, bandwidth thresholds exceeded 30 times in last month, etc.		
48	Network Management Tool should be capable of managing upto 30Kdevices from a single instance, should be able to have 1 mil discovered interfaces.		
	Network Performance Management		
49	Data collection and thresholding of network device ports (any that support MIB2 including virtual interfaces):Bytes In, Bytes Out, Discards, Errors, Network Delay		
50	Data collection and threshold setting of network devices: CPU, Memory, Buffers, Component statistics. Distribute reports by email in HTML, Excel or pdf formats.		
51	A variety of reports summarizing the data including: Home page summary, Calendar, Heat chart, Headline, Dashboard, Managed inventory report, Top ten, Most changed, Data explorer		
52	The solution should be able to consolidate a view of a large-scale network (30,000+device) across multiple instances and also support SDN.		
53	The solution should provide policy-based audit and remediation drives compliance and capacity and traffic analysis tools enable proactive planning.		
	Network Flow Traffic Monitoring		

Sl. No.	Specification	Supplier Response (Compliant/ Not Compliant	Remarks
54	It shall be able to capture, track & analyze traffic flowing over the network via different industry standard traffic capturing methodologies viz. NetFlow, jflow, sFlow,IPFIX etc.		
55	It shall provide key performance monitoring capabilities by giving detailed insight into the application traffic flowing over the network.		
56	It shall be able to monitor network traffic utilization, packet size distribution, protocol distribution, application distribution, top talkers etc.fornetworktraffic.		
57	It shall collect the real-time network flow data from devices across the network and provide reports on traffic based on standard TCP/IP packet metrics such as Flow Rate, Utilization, Byte Count, Flow Count, TOS fields etc.		
	Network Automation		
58	Manage network compliance by comparing devices to defined, best-practice standards. Speed audit processes without-of-the-box network compliance reports for ITIL and more. Validate device operating states in real time to stay in compliance.		
59	In real time, detect configuration and asset information changes made across a multi-vendor device network, regardless of how each change is made and also support configuration deployment/roll back and configuration templates		
60	In real time, store a complete audit trail of configuration changes ,(hardware, and software,)made to network devices, including critical change information.		
61	Manage device access and authorization through a centralized control model that is integrated with your standard workflow and approval processes.		
62	Enforce change processes in real time. Model complex approval processes with flexible rules. Force approvals for changes, including changes made by a direct command line interface(CLI)session.		
	Service Management (Help Desk) & SLA Management		
63	OGC Gold level certified (or equivalent) for ITIL v3 in atleast 10 processes or equivalent		
64	The CMDB should provide visualization (graphical view) as well as support federation (seamlessly federates information from other distributed data sources),reconciliation and synchronization.		

Sl. No.	Specification	Supplier Response (Compliant/ Not Compliant	Remarks
65	Should provide out-of-the-box categorization, as well as routing and escalation workflows that can be triggered based on criteria such as SLA, impact, urgency, CI, location or customer.		
66	The tool should allow the user to take a screenshot of the error message and sends it to the service desk. The user can type in a couple of text lines to describe the error in simple language. All of the details are completed automatically from the picture taken or the text description provided. The service desk agent then can pickup the ticket with the information already filled in (category, impact, and assignment).		
67	Should include automated impact analysis, calculated risk analysis, collision detection, and unplanned change detection and validation.		
68	Should support closed loop incident process to more quickly and accurately discover incidents and execute triage and remediation. Tightly integrated with other monitoring tools to leverage CLIP feature.		
69	Smart ticketing with good predictive analytics and machine learning applied on the Help desk solution.		
70	Must include accost estimation tool that enables users to select a subset of maintenance tasks, and then calculate the estimated cost to run those tasks within a specified time frame.		
71	If multiple SLAs are triggered, the strictest one must drive the workflow.		
72	The product must monitor SLAs against Service, Problem, and Change Management.		
	Service Level Reporting		
73	The solution must provide Out of the box reporting templates for performance, availability, operation, virtualization and capacity and audit.		
74	The solution should provide reports that can prove IT service quality levels, such as application response times and server resource consumption.		
75	The system reports should be accessible via web browser and Reports can be published in PDF and cs format.		
76	The solution must provide Reports that can be scheduled to publish automatically or they can be produced on demand.		

Sl. No.	Specification	Supplier Response (Compliant/ Not Compliant	Remarks
77	The solution should be able to report in the context of the business services that the infrastructure elements support—clearly showing how the infrastructure impacts business service levels.		
78	The solution should provide Business Service Management functionality to track Service quality by logically grouping Network, Server and Application components. The solution should provide correlation between Network, Server and Application to identify the business impact from the specific event or alarm.		
79	The solution must provide way to define key performance indicators (KPIs)within the Service Quality report.		
80	The solution must provide SLA measurement to track service quality from both Availability and Performance perspective.		
81	Scalability– Service Level Reporting solution should be scalable ,it should be capable of supporting upto 20000 system nodes, 20000 network nodes with capability to support in excess of 700 KCIs if need be		
	Asset & Inventory Management		
82	Asset Managerenables IT organizations to manage the physical, financial and contractual aspects of all IT assets—from request and procurement to retirement and disposal—making it easy to optimize costs, mitigate security and compliance risks and drive business decisions. It should automatically discover and inventory enterprise IT assets which reduces compliance risks, enable software license optimization & chargeback & constantly track changing asset configurations		
83	AM should provide a built-in work flow to suggest to the software asset managers in user organization that they should request more licenses or remove installed software that is not in use or assign rights to others users rather than procuring more licenses		
84	AM will directly alert users whenever a software installation exceeds the purchased volume. AM will also automatically ensure that no additional users are able to subscribe to that software until additional licenses are made available.		
85	Software Asset Management should be capable of doing software compliance of atleast 600+software titles and versions ,3000 +licenses.		

Sl. No.	Specification	Supplier Response (Compliant/ Not Compliant	Remarks
86	Software Asset Management should be capable of doing license compliance for vendors like HP, Microsoft, IBM (PVU), Oracle, VMware, Symantec, Autodesk, Adobe, TIBCO, Red Hat, BMC etc.		
87	Able to manage inventory as individual or bulk items, set re-order levels and amounts and keep a history of transactions		
88	Able to provide ability to account for assets and components in inventory and facilitates maintaining appropriate levels of stock		
89	Provide a tab that stores sub-components information of the asset.E.g.ID, Serial Number, Licenses, Version, Status, Category, Type, Item.		
90	Provide a tab that stores different types of contracts: Lease, Support, Warranty, Software, Maintenance		
91	Provide a tab that stores associated costs by cost center, budget code, and project. Static and incident costs. Provide Straight line depreciation cost calculation.		
92	Able to track the total cost of ownership for an asset		
	Auto Discovery &Inventory		
93	Discovery should work without requiring agent installation (that is, agent-less discovery) while discovery Layers 2 through Layers 7 of OSI model		
94	Should use Industry-standard protocols such as WMI, SNMP, JMX, SSH to perform discovery without requiring the installation of an agent		
95	Discovery system should have ability to modify out-of-box discovery scripts, create customized discovery scripts		
96	Discovery system should be capable of supporting role-based access to various aspects of CMDB administration		
	Role-Based Access Control		
97	The solution should have in built role-based access module to enable multiple users with different groups to create dashboards specific to their department.		
98	The Solution should have way to control and define permission such as read/write for set of devices rather than all the devices for the ease of use.		
	Other Key Requirement		

Sl. No.	Specification	Supplier Response (Compliant/ Not Compliant	Remarks
99	The Solution should provide all the modules as a single monitoring engine to correlate events in real-time from Networks, Servers and Applications.		
100	The solution should be deployable on Linux operating systems to reduce the overall TCO.		
101	The solution should run without any propriety data base license for datastore-Data store must be bundled within EMS (E.g. popular time-series, no-sql, HBase based monitoring systems) to reduce the TCO.		
102	The solution must provide way to define key performance indicators(KPIs)within the Business Service Management module.		

4. Detailed Technical Specifications of Desktop PC:

Sl. No.	Parameter	Specification	Supplier Response (Compliant/ Not Compliant	Remarks
Desktop				
1	Processor	Intel® 7th Generation Corei5 7500 CPU with minimum base frequencyof3.4 GHz, 6 MB Cache or better		
2	Chipset	Compatible latest Generation chipset		
3	Motherboard	OEM Motherboard with OEM logo embossed on the motherboard (No Sticker)		
4	Memory	8 GB DDR4 RAM expandable to 32GB,TwoDIMMslots;Non-ECCdual-channel upto 2400MT/s DDR4 SDRAM		
5	HDD&	1 TB HDD, 7200 RPM, SATAIII6 Gbps, SMARTIV		
6	Optical Drive	DVD Writer		
7	Graphics	Integrated Intel® HD Graphics630 or higher		
8	Audio	High Definition Integrated Audio with Internal Speaker		
9	Ethernet	Integrated Gigabit (10/100/1000 NIC)LAN		
10	Slots	Minimum3 PCIe slots(atleast2 PCIExpressx16)&1M.2 PCIe x1 slot		
11	Bays	3 Bays (1 external&2 internal)		

Sl. No.	Parameter	Specification	Supplier Response (Compliant/ Not Compliant	Remarks
12	Ports	Minimum8 USB Ports of which atleast2 USB Ports in Front		
13		Front I/O: (2)USB3.1 Gen1 Ports, Universal Audio jack		
14		Rear I/O: (4)USB2.0 ports, (2)USB3.1 Gen 1Ports, (1)VGA video port;(1) Display Port Port, (1)RJ-45 network connector, (1)RS-232 serial port,(2)PS/2Ports, 3.5mmaudioin/out jacks		
15	Form Factor	Tower		
16	Power Supply	Min 300 Wor higher active PFCPowerSupply85%efficiency		
17	Keyboard/Mouse	USB104 keys keyboard (Same make as PC),USB2 Button Scroll Mouse (Same make as PC)		
18	Operating System	Genuine Microsoft Windows 10 Pro64-bit		
19	Diagnostics Tool	Inbuilt Pre-Boot BIOS Diagnostics		
20	Security	TPM 1.2 Security Chip, SATA port disablement(via BIOS), Serial, USB enable/disable(via BIOS), Removable media write/boot control, Power-On password(via BIOS), Administrator password (via BIOS), Setup password(via BIOS),Support for chassis padlocks and cable lock devices		
21	Compliance &Certification	EnergyStarver6.1, EPEAT Certified for India for quoted desktop & Monitor, TCO Certified for both Desktop &Monitor, FCC, CE, RoHS certified, UL Certified ISO9001, 14001, 27001,Certified OEM		
22	Information Accessibility	Product details, specifications and brochure to be available in public domain		
23	Support	Drivers should be available for download from OEM siteforatleast5 years from the date of purchase order		
24	Monitor	19.5"orhigherIPS PanelLEDbacklitwithTCO7.0 and 1440 x 900 Resolution		

5. UPS - 600 VA Line Interactive INTELLIGENT UPS for Desktop PC

Sl. No.	Description/ requirements		Supplier Response (Compliant/Not Compliant	Remarks
1	• Capacity	600VALineInteractive		
2	• Backup Time	10Minuteson450VA Continuous Load; Overload capacity: 125% of required capacityforatleast1Minute		
3	• Input Voltage	170V to270V,50Hz+ 5%		
4	• Output Voltage	198to250(online),230+5% (On Battery) Automatic Voltage Regulation		
5	General Features	• Automatic Voltage Regulation, Lightning & Surge Protection		
		• Output Waveform— Modified Sinewave		
		• Audio Alarms: Low Battery; Battery ON; Overload Protection: Overload, Short circuit, spike & surge		
	SwitchingTime	Lessthan5MSwithoutdata loss		
	OperatingTemp.	Upto 40Deg.C.		
	OperatingHumidity	Upto 90%,Non-condensing		
9	Battery Type	SMF- Hitachi/ Exide/ Global Yuasa/ Panasonic make or equivalent		
10	Make	APC, Liebert, TVSE, Power ware (Invensys), Guard/NEXUS, Wep, HCL or equivalent		
11	Others	OutputSockets-Min3Nos.,each6Amp-3Pin with all Sockets wired for UPS output Socket of UPS must be compatible with PC and Printer.		
		UPS input power plug should be of Indian standard.		
		Software: Required for health monitoring of battery & Power mgmt. system RS232-C Serial port or USB port with interface cable, Min 3Ft Long.		

6. UPS & BATTERY SYSTEM for Data Center & Disaster recovery Center:

Sl.No.	Description/ requirements	Supplier Response (Compliant/ Not Compliant	Remarks
1	The scope shall include design, detailed engineering, manufacture,supply, transportation, storage, unpacking, erection, testing, successful commissioning and satisfactory completion of trial operations of following for the DataCentre.		
2	UPS: The Data Center & Disaster recovery Center equipment should get continuous power.		
	The Solution uptime should be 99.5%.		
	The redundancy should be available upto the load end.		
	Preferred makes of UPS are Merlin Gerin, Emerson Network power, DB Power Electronics or Power ware.		
3	Critical Load UPS. 2 nos. UPS of adequate capacity with independent battery back up for 30minutes for serving the critical loads..		
	Input/Output details:		
	InputVoltage:380/400/415V Three Phase		
	Out Put : 415V Three Phase(4Wire)		
4	Service Load UPS. 2nos. UPS of adequate capacity with COMMON battery back up for 30minutes for other loads.		
	Input/Output details:		
	InputVoltage:380/400/415V Three Phase Bypass		
	Input:415VThree Phase(4wire)		
	Out Put : 415V Three Phase(4Wire)		
	Both the UPS should be able to operate in independent and synchronized mode.		
5	The critical load UPS system shall operate without synchronization at the output. Each unit shall separately feed UPS distribution boards A & B in the power room		
6	The service load UPS system shall operate in dual bus synchronized mode such that both are independent but their output bus is synchronized forming the service UPS board, sharing the load. If any UPS is down the other shall take the entire load. They also should be able to operate in one cold standby mode. All emergency lighting of the facility, PC/Terminal loads etc. shall be fed from this system.		
7	**CRITICALLOADUPS**		

Sl.No.	Description/ requirements	Supplier Response (Compliant/ Not Compliant	Remarks
8	Two numbers of UPS to be provided for meeting the critical load requirements. The UPS shall be designed to operate as an ON LINE Double conversion type reverse transfer system with static switch, manual by pass switch, isolation transformer at inverter output and AC distribution boards. It shall have charger, inverter and individual VRLA type battery bank for 30 minutes power backup at full load. The rectifier shall operate on 12pulse rectification. The offered system shall have the following operation modes.		
	A. Normal - The critical AC load is continuously supplied by the UPS Inverter. The rectifier/ charger derives power from AC Input source and supplies DC power to the Inverter while simultaneously load charging power reserve battery.		
	B. Emergency-Upon failure of AC Input power, the critical AC load is supplied by the Inverter, which without any switching obtains power from the battery. There shall be no interruption in power to the critical load upon failure or restoration of the AC input source.		
	C. Recharge - Upon restoration of AC input power during theemergency mode of operation, the rectifier/ charger shall automatically restart, walk-in and gradually assume the inverter and battery recharge loads.		
	D. Bypass–If the UPS must be taken out of service for maintenance or repair or should the inverter overload capacity be exceeded, static transfer switch shall perform reverse transfer of the load from the inverter to by pass source with no interruption in the power to the critical AC load. The static bypass switch should be double ended. The static switch should also have an overload rating of 14times of rated load for 10 m sec (1/2cycles). The use of this static switch is at the discretion of the owner.		
	E. A manually operated Maintenance Bypass Switch should be incorporated into UPS cabinet that will connect the load to ACpower source bypassing the rectifier/charger, Inverter and Static transfer switch.		

Sl.No.	Description/ requirements	Supplier Response (Compliant/ Not Compliant	Remarks
9	The Critical load UPS shall be used to feed critical server and other equipment installed in Critical server. The sizing for the same shall be furnished along with calculations. The KVA rating of UPS shall be as required by expected loads(and include 10% spare capacity guaranteed at 40deg.Cambientandloadpower factor of 0.8lagging. Each UPS shall be sized for 100%+10% ofcriticalserverloads002EIf UPSKVA rating is applicable at a lower ambient temperature than specified 40 deg.C, the Bidder shall consider a derating factor of at least1.5%/deg.C for arriving at the specified UPS capacity at 40 deg.C ambient. The UPS shall have an overload capacityof125% rated capacity for 10 minutes and 150% rated capacity for 10 seconds. The inverter shall have sufficient capability to clear fault in the maximum rated branch circuit, limited to 12 percent of finally selected UPS Capacity. The sizing of UPS shall be based on the power factor of the loads being fed subjecttoamaximumof0.8.		
10	The charger shall be sized to meet the 100% UPS load plus recharge the fully discharged battery within 8hours at minimum charger efficiency of 90%.The input to the UPS shall be unregulated 3 phase AC of415Volts.		
11	Battery Requirements: Battery should be designed for giving 30minutes back up at full load on each UPS. Valve Regulated Lead Acid (VRLA) type suitable to be installed along with UPS to be considered. The UPS battery shall be made of 2VVRLAcellswithadesignlifeof minimum15years.Thebatterytobeinstalledin multi-tier configuration effectively using the space available with considerations for maintenance accesses. The UPS module should have the Battery Circuit breaker mounted near to the batteries. When this breaker is opened no battery voltage should be present in the UPS enclosure. The UPS module should be automatically disconnected when the battery reaches to the minimum discharge voltage level or when signalled by other control functions. Remote tripping of Battery Circuit breaker facility shall be also incorporated. The entire tier system complete with cabling shall be supplied.		
12	The UPS battery shall have sufficient amp-hour capacity (not lesst than 600 AH) to supply 100% full load current of UPS for 30 minutes. Battery sizing along with detailed calculation shall be provided. The UPS along with batteries are proposed to be installed in the power room under precision air conditioned environment at 22degreeC+/-1degree. This factor to be considered while arriving at battery sizing		

Sl.No.	Description/ requirements	Supplier Response (Compliant/ Not Compliant	Remarks
13	The UPS system shall be capable of operating without D.C. battery in circuit under all conditions of load and the performance of various components of UPS like inverter, charger, static switch etc. shall be guaranteed without the battery in circuit		
14	Static Inverters: The static inverter shall be of continuous duty, solid state type using proven Pulse Width Modulation (PWM)/Quasi square wave/step wave technique. Ferro resonant types Inverters are not acceptable. The inverter equipment shall include all necessary circuitry and devices to conform to requirements like voltage regulation, current limiting, wave shaping, transient recovery, automatic synchronization etc. The steady state voltage regulation shallbe+2%andtransient voltage regulation (on application/removal of 100%load) shall be +20%.Time to recover from transient to normal voltage shall not be more than 50milliSec. Frequency regulation for all conditions of input supplies, loads and temperature occurring simultaneously or in any combination shall be better than± 0.5% (automatically controlled).The total harmonic content shall be5% maximum and content of any single harmonic shall be3% maximum. The inverter efficiency shall be at least 90% on full load and 80% on 50% load. Each Inverter shall have an overload capacity of125% rated capacity for 10 minutes and 150 % rated capacity for 10 seconds. An isolation transformer shall be provided at the output of the inverter. The output of the UPS shall be 3 phase with grounded neutral (4wire).		
15	Static Switch and Manual Bypass Switch: The static switch shall be provided to perform the function of transferring UPS loads automatically without any break from faulty inverter to standby AC source in case of failure of the inverter. The transfer time shall be¼ cycle maximum. Manual by pass switch shall be employed for isolating the UPS during maintenance. Continuous and overload capacity of the switches shall be equal to 100% of the continuous and overload rating of each invertors. Peak Capacity shall be 1000% of continuous rating		

Sl.No.	Description/ requirements	Supplier Response (Compliant/ Not Compliant	Remarks
16	Static Switch: Each single phase load points shall be provided with an automatic static switch to choose from both the sources.(All racks shall be provided with one static switch).This is intended to make power continuity to critical loads in the event of change over of supply from one source to the other. Shall have two inputs and give one output. One of the two AC inputs should be designated as the "preferred" source to which the Static Switch will connect the load as long as the designated input source should be within acceptable voltage limits. If the preferred source falls outside the acceptable limits, the Static Switch should be designed to transfer the output load to the other "alternate" input source, as long as the alternate source should be within acceptable voltage limits and should be synchronized with the preferred source within the selected phase synchronization window. The Static Switch shall provide fast, break-before-make transfers to prevent interconnection of the two sources, even under faulted source conditions. The maximum sense and transfer times must be within the tolerance of IEEE Standard 446 susceptibility curve for information technology equipment to allow uninterrupted load equipment operation. In case of overload, Static Switch must give the alarm. Short circuit condition of the load should be protected by a fast acting semi-conductor fuse. The Static Switch should be of two modules. Fixed module should consist of the input and output connections and manual bypass transfer control switch. Second module should be hot swappable plugin type removable electronics& static switching module. The bypass/transfer control switch should be located behind a key locked hinged access cover to restrict access to qualified or designated operators. The plug in module should have keylocked latches to prevent unauthorized removal of the module. The Static Switch should be designed to allow replacement of the removable electronics/switching module without having to de- energize the load equipment. The Static Switch should have alive mimic display the current status of the unit. This mimic must be located on the removable electronics module. Mimic should be active as long as atleast one source is on. The fixed module of the Static Switch should also have live mimic indicating the status of source & load even if hot swappable electronic module should be removed.		
17	Specifications:		
	Manual and Automatic Transfers.		
	Sense and transfer time: Less than6milliseconds.		

Sl.No.	Description/ requirements	Supplier Response (Compliant/ Not Compliant	Remarks
	Break-Before Make-switching.		
	Selectable Preferred Source.		
	Selectable Auto/Manual Retransfer.		
	In-Phase Transfer Window:Adjustable from20V to100V		
	Convection cooling.		
	Hot swappable electronic static switching module		
	Live mimic on electronic static switch module for indicating load supply status & alarms.		
	Live mimic on fixed module to indicate supply status even withelectronic module removed.		
	Make before break manual bypass switch to transfer load from static switch to direct source 1or source 2. Rack Mountable with 2U size Nominal Input Voltage 220, 230 or 240 volts single phase,2W+G,50Hz. Solidly grounded power sources.		
	Source unhealthy status–Adjustable from -10to–20%ofnominalvoltage		
	Maximum continuous source25A,50Hz		
	Load Power factor range:0.5to 1.0leadingor lagging		
	Load Crest factor: upto 3.5.		
	Source voltage distortion: upto10%THD		
	Overload capability:125% of continuous current for 2hours,1000%for two cycles minimum.		
	Over current Protection: By semiconductor fuse		
	Short circuit withstand capability: upto20,000 symmetrical amps, protected by internal fusing.		
	Redundant Control Power supplies.		
	Integral Maintenance Bypass.		
	Eight Isolated Normally Open alarm & static switch Status Contacts.		

7. Printer & Scanner:

Sl. No.	Parameter	Specification	Supplier Response (Compliant/ Not Compliant	Remarks
Mono Laser Printer				
1	Type	A4 Mono Printer		

Sl. No.	Parameter	Specification	Supplier Response (Compliant/ Not Compliant	Remarks
2	Print Technology	Laser jet		
3	Print Speed (A4)	25 PPM or higher		
4	Duplex Printing	Required, Automatic		
5	Duplex Print Speed(A4)	15 PPM or more		
6	Print Resolution	1200*1200dpiorbetter		
7	Processor Speed	750MHzorabove		
8	Memory	128MB or higher		
9	Duty Cycle	15000 pages or more		
10	Recommended Monthly Page Volume	2000 Pages or more		
11	Connectivity	1 x USB2.0, 1 x Ethernet,Wi-Fi802.11g/n		
12	Input Tray	Main Tray of 250 sheets or more, Priority Tray of 10 sheets or more		
13	Output Tray	150 Sheets or more		
Flatbed Scanner				
1	Type	A4 Flatbed Scanner with ADF		
2	Scan Technology	CMOS CIS		
3	Scan Speed (A4)	20 PPM or better		
4	Duplex Scanning	Required		
5	Duplex Scan Speed	40 IPM or better		
6	Scan Resolution	Minimum600*600 dpiinADF,1200*1200dpiorbetter		
7	Daily Duty Cycle (ADF)	1500 pages or more		
8	Memory	64MB or better		
9	Processor Speed	120MHzorhigher		
10	Scanning Options (ADF)	Single Pass Duplex		
11	Bit Depth/Gray Scale Level	24bit/256 or better		
12	Supported Paper Weight (ADF)	60 to 105 GSM or better		
13	Connectivity	USB2.0		

8. SERVERS:

Technical Specification		
Make and Models offered		
S No.	**Parameter**	**Specification**
1	Processor	Server should be configured with two in numbers Intel Xeon Gold 6132 14C processors 2.66GHz
2	Chipset	Intel C600 series chipset or better

Technical Specification		
Make and Models offered		
S No.	**Parameter**	**Specification**
3	Memory	Server should be configured with 256 GB of ECC DDR4 Memory and scalable up to 1024 GB memory
4	DIMM Slots	Server should support 24 DIMM Slots memory configurations
5	Hard Disk Drives	Server should be configured with 4 * 300GB 10K SAS 6Gbps 2.5in-HS HDD scalable up to 8 drives.
6	RAID Controller	Integrated hardware RAID controller and should support hardware RAID 0, 1, 5. Offered controller should have minimum 512 MB battery backed cache.
7	Optical Drive	Server should be configured with single DVD-RW drive
8	Graphics Controller	Minimum 16MB Memory
9	Gigabit Ethernet Ports	Server should be configured with minimum four number of 1Gigabit Ethernet ports
10	Storage Connectivity	Server should be configured with two dual port 16Gbps Fiber Channel adapter to connect to external storage.
11	Additional Ethernet Ports	Server should be configured with 2 Number of 10G Fiber Ethernet Ports with SFP; along with compatible transceivers
12	PCI Slots	Server should support minimum 3 PCIe slots with dual processor configuration.
13	Ports	Server should support 4 Number of external USB 2.0/USB 3.0 ports. Also it should support one Video port and an Ethernet Management port
14	Redundant Power Supply	Server should be configured with Dual redundant power supplies with 80 PLUS Platinum certification or similar energy efficient certifications
15	RAS feature	Should have RAS features such as Hot swappable disks, Hot pluggable Power Supplies, Cooling fans etc.
16	Management Functionality	Should support integrated management with remote presence, Server should be supplied with Server Management software
17	Form Factor	2U Rack
17	Cables & Accessories	All required LC-LC cable, Ethernet cable, Power cables, sliding rails, mounting kit etc. to be provided
18	OS Support	Offered hardware should support latest OS versions of Windows & Linux such as server 2012, server 2016, RHEL 7, SUSE 11, SUSE 12 etc. & further upcoming versions
19	Virtualization support	Offered server must support market leading virtualization software such as Hyper-V, VMware, OVM, Red hat virtualization etc.
20	Warranty	7 Years Comprehensive Onsite Hardware Warranty 24*7 with 4 hr. response time

Sl. No.	Specification	Supplier Response (Compliant/ Not Compliant	Remarks
Servers			
Scope Of Work			
1	Prepare landscape/diagram and deliverable SOW.		
2	Mounting of the devices.		
3	Installing the related hardware/software components.		
4	Complete configuration of the device to integrate with the existing setup.		
5	Implementation and Documentation of the same.		
6	Testing all the services.		
7	Provide Hands on Training for OPTCL/WESCO Team.		
8	Bidder should complete the project as per the agreed time		
9	Bidder shall maintain the system during Warranty and AMC period as per Service Level Agreement mentioned in RFP document.		
10	**Any system though not specifically mentioned, but is required to complete the project in all respects for its safe, reliable, efficient and trouble free operation shall also be taken to be included and the same shall be supplied and installed by the Bidder without any extra cost.**		
1	Unified storage solution with support and configuration for both NAS and SAN functionality.		
2	Storage shall have true active-active controller design so that a single logical unit can be shared across all offered controllers in symmetrical fashion, while supporting all the major functionalities like Thin Provisioning, Data Tiering etc. Additionally purpose built ASIC, XOR or x86 based engine should be offered so that there shall be no load on the storage CPU during RAID Parity calculations.		
3	Offered Storage Array shall be given withMinimumof64GB DRAM cache in a single unit and shall be scalable to 128GBDRAM without any controller change. Minimum2 controller storage scalable to 4 or more controller need to be proposed. Storage should support cache backup functionality. Offered Storage array shall also have additional support for Flash Cache using SSD/Flash drives. Both File services as well as Block operations shall be able to utilize flash cache. More than 1000 GB Flash cache shall be supported.		
4	Support for SSD, SAS & NL-SAS disks within same storage system and enclosure		
5	It should support hardware RAID levels 0, 1, 10,5 and6		

Sl. No.	Specification	Supplier Response (Compliant/ Not Compliant	Remarks
6	The storage must be configured with minimum 50 TB usableCapacity.Minimum20TBinSSDand30TBinSAS10Kdrives. Entire production capacity to be directly pinned on SSD. Bidder needs to factor additional capacity as required to fulfil proposed solution requirement. The storage system must support at least 450Drives scalability.		
7	180Gbps FC frontend scalable to 360Gbps via FC and 180 Gbps SAS/FC backend scalable to 360Gbps without any controller change. Storage should be configured with thin provisioning and automatic thin reclaim software		
8	Storage should be configured with thin provisioning and automatic thin reclaim software.		
9	It should support heterogeneous client OSs, which includes all popular flavours of Windows and Linux.		
10	Dedicated management and replication ports.		
11	Offered Storage Array shall be configured in a No Single Point of configuration including Array Controller card, Cache memory, FAN, Power supply etc. The same should support2048 LUNs/Initiators		
12	The storage must have the capability to expand LUNs/volumes online. Every supplied disk shall be able to participate into multiple and different RAID sets simultaneously. Offered storage shall support dynamic migration of Volume from one RAID set to another set while keeping the application online.		
13	Must support for creation of point-in-time copies/snapshots		
14	The storage should be configured with Thin provisioning and thin reclaim licenses. Storage array should support real time automated tiering at Sub-LUN level across all the 3 tiers of storage, i.e, SSD, SAS and NL-SAS. It should support simultaneous movement of Sub-LUN data from NL-SAS to SAS to SSD and vice versa based on application I/O workload.		
15	Must support replication features(Synchronous and Asynchronous)for both file and block. Must support three site replication features natively.		
16	Comprehensive management software for fully managing and administering the storage including deployment, automation, provisioning and monitoring		
17	All necessary cables for enclosure interconnections must be part of the storage system supply		

Sl. No.	Specification	Supplier Response (Compliant/ Not Compliant	Remarks
18	Storage subsystem shall be supplied with Thin provisioning, Snapshot, Clone, Performance Monitoring, Online Raid Migration, Online Volume conversion, Quality of services, Sub-LUN data tiering for the maximum supported capacity of array.		
19	OEM Criteria: OEM of the proposed solution should be listed in Leaders Quadrant of Gartner's latest report for storage array. Storage Array, SAN Switch and Tape Library must be of the same make.		
	SAN Switch		
1	Shall be configured with minimumof24 ports. All ports should be populated with minimum16 Gbps SFP's and 24 no of 5Mtr LC-LC cables need to be provided. SAN Switch is to be supplied in 1+1Redundant configuration.		
2	Required scalability shall not be achieved by cascading the number of switches and shall be offered within the common chassis only		
3	Should deliver16 Gbit/Sec Non-blocking architecture with 1:1performance for upto 24 ports in a energy-efficient fashion		
4	Should protect existing device investments withauto-sensing4, 8,and 16 Gbit/sec capabilities.		
5	The switch shall support different port types such as FL_Port,F_Port,E_Port,EX_Port.		
6	The switch should be rack mountable		
7	Should provide enterprise-class availability features such as redundant and hot pluggable components like power supply and FAN		
8	Non-disruptive Microcode/ firmware Upgrades and hot co deactivation.		
9	The switch shall provide Aggregate bandwidth of 384Gbit/second to end.		
10	Switch shall have support for web based management and should also support CLI.		
11	The switch should have USB port for firmware download, support save, and configuration upload/download.		
12	Offered SAN switches shall be highly efficient in power consumption. Bidder shall ensure that each offered SAN switch shall consume less than 100 Watt of power.		

Sl. No.	Specification	Supplier Response (Compliant/ Not Compliant	Remarks
13	Switch shall support POST and online/offline diagnostics, including RAS trace logging, environmental monitoring, non-disruptive daemon restart, FC ping and Path info (FC traceroute), port mirroring(SPAN port).		
14	Offered SAN switch shall support services such as Quality of Service (QoS)to help optimize application performance in consolidated, virtual environments. It should be possible to define high, medium and low priority QOS zones to expidite high-priority traffic		
15	The switch shall be able to supportISLtrunkupto128Gbit/sec between a pair of switches for optima l band width utilization and load balancing.		
16	SAN switch shall support to restrict data flow from less critical hosts at pre-set bandwidths.		
17	It should be possible to isolate the high bandwidth data flows traffic to specific ISLs by using simple zoning		
18	TheSwitchshouldbeconfiguredwiththeZoningandshallsupportISL Trunkingfeatureswhencascadingmorethan2numbersofSANswitc hesinto a single fabric.		
19	Offered SAN switches shall support to measure the top bandwidth-consuming traffic in real time fora specific portora fabric which should detail the physical or virtual device.		
20	OEM Criteria: OEM of the proposed solution should be listed in Leaders Quadrant of Gartner's latest report for storage array. Storage Array, SAN Switch and Tape Library must be of the same make.		

Tape Library

Sl. No.	Parameter	Specification	Supplier Response (Compliant/ Not Compliant	Remarks
1	Capacity	Shall support Native data capacity of 1 PB (uncompressed) expandable to 2PB (2.5:1 compressed). Shall be offered with Minimum of six LTO7 FC tape drives. Tape Drive shall support encryption. Shall be offered with 80 Cartridge slots.		

Sl. No.	Parameter	Specification	Supplier Response (Compliant/ Not Compliant	Remarks
2	Tape Drive Architecture	Offered LTO7 drive in the Library shall conform to the Continuous and Data rate matching technique for higher reliability.		
3	Speed	Offered LTO7 drive shallsupport160MB/sec in Native mode and 400MB/sec in2.5:1 Compressed mode.		
4	Scalability	Tape Library shall be scalable to 500slotsand 40numberofLTO-7 Drives within the same Library.		
5	Connectivity	Offered Tape Library shall provide native FC connectivity to SAN switches.		
6	Partitioning	Offered Tape Library shall have partitioning support so that each drive can be configured in a separate partition. Offered Tape Libraryshallhavesupportforat-least20 partition.		
7	Management	Tape Library shall provide web based remote management.		
8	Encryption device	Offered Library shall be provided with a hardware device like USB key, separateapplianceetc.to keep all the encrypted keys in a redundant fashion.		
9	Barcode Reader and Mails lots	Tape library shall support Barcode readerandat-least5 mail slots and shall be scalable to 30 mail slots.		
10	Other Features	Tape Library shall have GUI Panel and shall be rack mountable. Shall be configured with redundant power supply. Tape Library shall be supplied with software which can predict and prevent failures through early warning and shall also suggest the required service action. Offered Software shall also have the capability to determine when to retire the tape cartridges and what compression ratio is being achieved. The storage, tape Library and Backup software should be from the same OEM for end to end support matrix of the OEM and single mode of integration		

Sl. No.	Parameter	Specification	Supplier Response (Compliant/ Not Compliant	Remarks
11	OEM Criteria	OEM Criteria: OEM of the proposed solution should be listed in Leaders Quadrant of Gartner's latest report for storage array. Storage Array, SAN Switch and Tape Library must be of the same make.		

9. Storage Item:

SAN Storage : The Storage system should be unified (Block and File), with minimum **X** TB usable capacity in RAID 5 (4+1). Bidders must include 1 Hot Spare drive for every 12 drives. It should contain at least 64 GB cache per controller.
Disk Type : Disk types are 600/900 GB (10K/15K SAS Drives). Flash Drives - 200/400 GB
Scalability : Storage should be scalable to minimum 4 times of its usable capacity in alignment with supplied specification.
IOPS Requirement : Storage must provide minimum 35,000 IOPS with write to read ratio of 30:70.
RAID Type :RAID 5, RAID 6, RAID1
Fault Tolerance : The SAN component must be redundant against power supply, disk, cooling fan, controllers, and Data Path failures. The Central Storage System must support multi-path automatic load balancing with no single point-of-failure
Market Positioning : OEMs must be in the Gartner Lead quadrant for General Purpose Storage at least once in last 3 years.
Storage Features : Storage must contain features such as De-Duplication, Compression, Thin Provisioning, auto tiering etc.
Host Interface : Storage should contain minimum 4 No. of FC 8/16 Gb/s ports and 2 No. of 1/10GbE iSCSI ports. These ports must have backward compatibility. Storage should have at least 4 ports of 12 Gbps SAS backend across controllers.
Compatibility : Storage must be configurable with existing 8/16 Gbps EMC Switches & EMC Networker 9.0 or later Software
DAE & Cables : Bidder should provide the necessary DAE & extension cables required for storage commissioning.
Storage should be able to support Unified (SAN and NAS) as an integrated offering with single management tool with all mentioned protocols FC, iSCSI, CIFS, NFS etc. (FCoE is optional)
Remote Data Replication : The storage must support hardware based (host independent) data replication

to a remote site and bidirectional data copy.
Monitoring : The storage must have built in feature to provide automated email alerts. Monitoring tool should provide a comprehensive view into the health of the storage device(s) through a centralized management console. It should be able to monitor all logical connections and physical infrastructure
Trending and reporting : Storage must have feature to extract and capture utilization and performance reports.
Remote Management : Storage must have feature to manage remotely via web and command line.
Guest Operating System Support : Storage system must support following guest operating system Windows Server 2008,2012,2016 Red hat Linux, IBM AIX, Solaris, SusE Linux etc technology equipment.
Virtualization Support : Storage system must support following guest virtualization technologies – VMWare, Hyper-V, RHEV, OVM, Power VM etc.
Fault Detection & Corrective Action : Automatic drive failure detection and rebuild using global hot spare. Mirrored data cache with battery backup and de-stage to flash.
Multi pathing : The Central Storage System must support multi-path automatic load balancing with no single point-of-failure between Servers, Central Storage System and SAN.
Service Support & Warranty : Storage should have comprehensive 7 years onsite warranty

Storage	
Scope Of Work	
	SupplyandInstallationofdevicesatDC&DRlocationasperthespecificationintechnicalsection.
2	Supplied SAN devices(disks, Enclosures & cables) should be compatible and mountable in present Storage Rack,if any requirement of additional racks,it is to be provided by the bidder.
3	Supplied items must conform to the detailed technical specifications mentioned in this tenderdocument.
4	For handling the required capacity, proportionate number of controllers also must be added.
5	Any system though not specifically mentioned, but is required to complete the project in all respects for its safe, reliable, efficient and trouble free operation shall also be taken to be included and the same shall be supplied and installed by the Bidder without any extra cost.
6	Bidder shall maintain the system during Warranty and AMC period as per Service Level Agreement mentioned in RFP document.
7	Support & warranty to be co-terminus and in line with existing storage.
8	Bidder should provide the necessary cables required for storage commissioning.

10. Tape Library

a. The Enterprise Class Tape library of minimum 60 TB of native storage capacity using LTO-7 Tapes to be quoted

b. Scalable up to 400 TB native storage capacity.

c. Required LTO-7 Data cartridge slots and Cleaning slots along with minimum **4** numbers of LTO-7 Drives in single rack, Quoted Tape library

d. Tape drives should support LTO-7 tapes

e. The Tape Library should support barcode reading. Supply should include fully populated LTO-7 tape media (6 TB Native and up to 15 TB Compressed) along with Barcode labels. Additional barcode labels of 1 set (300 labels) to be supplied.

f. The Tape Library should be quoted with no of LTO-7 cleaning cartridges.

g. Tape Library should provide remote monitoring capability (Ethernet based management port), hot swap tape drives, dual power supplies and redundant cooling fans.

h. Offered Drive Interface should be 8/16 Gb Native Fiber Channel LTO-7 drives

i. Offered Drive should have native speed of up to 300 MB/sec and a compressed speed of 750 MB/sec for 2.5:1 compression.

j. Tape Library should be supplied with 16 I/O interfaces as per the quoted 4 number of drives.

k. Tape Library should have GUI touch panel.

l. Tape Library should have a mechanism to hold Persistent history and intelligent analysis of events and logs for easy troubleshooting.

m. The Tape Library should support UNIX, Linux and Windows operating Systems as backup clients.

n. The Tape Library should be SMI-S/ (SNMP& SMTP) complaint.

o. The Tape Library should be capable of auto cleaning of drives.

p. Quoted Library should support multiple Backup Software (Commvault, Networker, Symantec, HP, Dell, Tivoli etc.) and Backup Server Platforms.

q. Must support NDMP Protocol, IPv6 (Phase 2 and USGv6 certified) and IPv4 network protocol support

r. Tape Library must support capacity expansion and path failover.

s. Proposed equipment should have a roadmap for next 7 years

11. Router

S. No.	Generic Requirements
1	**Performance Requirement**

S. No.	Generic Requirements
1.1	Minimum packet forwarding rate of 450 Kpps for 64 byte packets
1.2	At least 512 MB DRAM and 512 MB Flash.
1.3	Shall support high performance WAN traffic forwarding at minimum 100 Mbps for upto 300 users
1.4	The router shall have enough CPU capacity and Memory so as to efficiently meet all the functionalities laid down in the specifications. The bidder should specify the offered CPU and memory model.
1.5	Router shall support 19" rack mountings.
1.6	Router shall support Upgrade of Software through Flash Memory.
1.7	Router shall support on line software reconfiguration to implement changes without rebooting.
1.8	Router shall support interface cards for LAN and WAN connectivity including Gigabit Ethernet and Fast Ethernet, T1/E1, Channelized T1/E1, V.35/G.703 Serial.
1.9	Router shall be capable of working with 170-240 volts AC nominal at frequency 50+/-2 Hz.
1.11	Router should support external/internal redundant power supply
1.12	Router shall support a console port with RS-232 Interface for configuration and diagnostic purpose.
2	**Interface Required**
2.1	The router must be modular. The router shall support 8 port 10/100/1000 switching module
2.2	2x10/100/1000 Base-T routable ports
3	**Routing & Multicasting**
3.1	The router must have IPv6 feature from day 1
3.2	Static routing, RIPv1/2, RIPng, OSPFv2 and v3, BGP4
3.3	Inter-VLAN routing
3.4	High availability: VRRP/HSRP
3.5	Router shall support GRE and IPSec Tunneling
3.6	IGMP v1/2/3
3.7	Should be capable to work in L2 and L3 MPLS environment
3.8	PIM-SM, PIM-DM, PIM SSM
4	**WAN Features**
4.1	The router shall support following WAN protocol

S. No.	Generic Requirements
4.2	Ethernet, 802.1q VLAN, Point-to-Point Protocol (PPP), Multilink Point-to-Point Protocol (MLPPP), Frame Relay, Multilink Frame Relay (MLFR) , High-Level Data Link Control (HDLC), Serial, Point-to-Point Protocol over Ethernet (PPPoE) and ATM (PPPoA)
5	**Security - The router shall support following Security features**
5.1	PAP & CHAP as per RFC 1994.
5.2	Data Encryption as per 3 DES and AES-256 standards.
5.3	Generic Routing Encapsulation as per RFC 2784.
5.4	Proposed router should come with Dedicated Hardware for VPN encryption acceleration.
5.5	IP Sec based point to point secure tunnels.
5.6	Support for firewall features.
5.7	Router should support Intrusion Prevention System feature.
5.8	Access lists
5.11	MD5 Route Authentication as per RFC 1321
5.12	Multiple Privilege levels to provide different levels of access
5.13	Remote Authentication Dial in User Service (RADIUS) as per RFC 2138
6	**Quality of Service/Traffic Management**
6.1	Router shall support following quality of Service (QoS) features
6.2	Weighted Fair Queuing(WFQ)
6.3	IP Precedence i.e. Priority based on TOS field of IP ver. 4
6.4	Differentiated services (Diff. serve) i.e. priority based on DS Field of the IP ver.4
7	**Management & Service provisioning**
7.1	Management: Telnet, SSHv2, SNMP v3, DHCP, RADIUS, TACACS+
7.2	Monitoring: Syslog, Statistics, RMON, Alarm
7.3	Configuration rollback and pre-planned scheduled reboot facility
7.4	USB / RJ-45 based console port and auxiliary port for management
9	**Standards:**
9.1	Safety , EMI/EMC , FCC and NDPP certification compliance
10	**Humidity**
10.1	Minimum R Humidity: 10 to 85% non-condensing

12. Firewall

S. No.	Firewall Requirements
1	**General and Performance Specifications**
1.1	The Firewall shall be a non-ASIC based firewall and should have Multi core architecture to mitigate against the sophisticated threats
1.2	The Firewall shall have integrated Firewall, IPS, App control and VPN Functionality
1.3	Firewall shall deliver IMIX throughput of minimum 15 Gbps and must deliver 1 Gbps of NGFW (FW+IPS+App Control) throughput in production environment with real world traffic blend enabling logging, Natting and recommended security.
1.4	3DES/AES with SHA VPN performance shall be at least 5 Gbps
1.5	Firewall shall support 2 Million concurrent sessions scalable to 4 million in near future
1.6	Firewall shall support at least minimum 120,000 new Sessions/second.
1.7	The platform must be supplied with at least 8 x 10/100/1000Mbps interfaces port from day one and should support for at least 4 x 10GBaseF card addition in future.
1.8	Deep packet inspection (DPI) analysis through data stream-based inspection, vulnerability signatures, policy configurations, protocol identification, data normalization, and both clear-text HTTP and encrypted HTTPS connections.
1.9	The appliances must be supported with hardened OS with field upgradable options of RAM and I/O interface options
2	**Operational Modes**
2.1	The Firewall shall support Layer 2 (Transparent) mode and Layer 3 mode.
2.2	Firewall shall support static NAT; Policy based NAT and PAT (Port Addressed Translation).
3	**Firewall.**
3.1	Firewall shall provide TCP reassembly for fragmented packet protection.
3.2	Firewall shall be able to support a minimum of 1024 VLANs.
4	**VPN.**
4.1	Firewall shall support at least 1000 IPsec tunnels.
4.2	Firewall shall be capable of dynamic routing on VPN.
4.3	Firewall shall support SHA-1 and SHA-2 authentication. This shall be Hardware accelerated
4.4	Firewall shall support client based IPsec VPN Tunnels
4.5	Firewall shall be able to prevent against replay attacks.

S. No.	Firewall Requirements
4.6	Firewall shall support IPsec NAT Traversal/ALG.
4.7	Firewall must support IPS as an integrated functionality. IPS must be recommended by NSS Labs from past three years. The OEM must not be rated with “caution” in past three years.
5	**High Availability.**
5.1	Firewall shall support Active/Passive High Availability.
5.2	Firewall shall support Active/Active High Availability.
5.3	Firewall shall support device failure detection.
5.4	Firewall shall support link failure detection.
6	**Routing.**
6.1	Support for OSPF and BGP routing protocol
6.2	Support for VRRP and Link Failure Control
6.3	Firewall shall support static routes
6.4	Shall support Multicast with features like IGMP and PIM.
6.5	Shall support Multicast inside IPsec tunnel.
6.6	IPv6 Support
6.7	Shall support Virtualization (Virtual Firewall, Security zones and VLAN
7	**Firewall Management**
7.1	Firewall shall support Web based (HTTP and HTTPS)
7.2	Configuration and management. Central management device must be provided separate by managing at least 2 devices from day-1.
7.3	Firewall shall support Command Line Interface using console,Telnet and SSH.
7.4	Firewall shall support management via VPN tunnel on any Interface.
8	**Logging.**
8.1	Shall support Syslog server logging.
8.2	Shall support notification through email.
8.3	Shall have support for SNMP V1 to V3.
8.4	Support for voice protocols: H.323, SIP, and NAT/ ALG for H.323/ SIP.
8.5	Proposed appliances must have local storage capacity of min 500 GB from Day one(per appliance)

S. No.	Firewall Requirements
10	**Administration.**
10.1	Firewall shall support multilevel administration privilege and must be provided in HA
10.2	Firewall shall support software upgrades using secure web Interface
10.3	Shall support configuration rollback.
11	**Certification**
11.1	Proposed Next Generation Firewall OEM must be Leader / Challangers in Gartner Magic Quadrant for Enterprise Network NGFWs in last 3 years
11.2	Firewall shall have ICSA certification for Firewall.
11.3	Firewall OS shall be EAL 4+ certified
12	**Warranty**
12.1	All devices should come with five year manufacturer warranty
12.2	The appliances must be provided with 24*7 support and must be provided with Next business day replacement in case of device failure.

13. Layer-III Switch

a. Switch architecture should be fixed form factor / modular.

b. Switch should have minimum 48 x 1/10G Base-T Ports and 4 x 40G QSFP ports populated with following transceivers:
2 x 40G QSFP cables along with transceivers of 1 meter length for interconnecting redundant Aggregation switches over 160 gbps (Full Duplex).

c. Each Switch should have 1 expansion slot for future scalability of ports.

d. Switch should have internal redundant power supplies and fans from day one.

e. Switch should have wire-speed for all the packet sizes.

f. Switch should have non-blocking and distributed forwarding on all the ports.

g. Should have switching backplane of minimum 1.44 Tbps.

h. Should have Static Routing and VRRP from day 1. Should be scalable to support OSPF & BGP.

i. Should support PVST / PVST+ or equivalent spanning tree protocol

j. Should support Hot Standby Router Protocol (HSRP) or equivalent protocol to create redundant topologies.

k. Should support Unidirectional Link Detection Protocol (UDLD) or equivalent protocol to allow unidirectional links failure detection

l. Should support VTP or equivalent protocol for dynamic VLAN registration

m. Should support min 32K MAC addresses and min 4K active VLANs.

n. Should have minimum 16K IPv4/IPv6 routes and 2K Multicast Routes from day 1.

o. Should support minimum of 2K ACL's from day 1.

p. Support management using CLI, GUI, using Web interface. Additionally, management can also be done using NMS.

q. Should be quoted with 5 years direct OEM TAC support and Next Business day hardware shipment.

r. All categories of switches, Transceivers & Switch OS should be from same OEM.

s. The OEM must feature in the Leaders/ Challengers segment of the Gartner Magic Quadrant for Data Center Enterprise Networking published in year 2016.

14. Backup Software

Sl. No.	Specification	Supplier Response(Compliant/ Not Compliant	Remarks
	Backup Software		
1	The proposed backup solution should be available on various OS platforms such as Windows, Linux and UNIX platforms		
2	The proposed back up solution shall support industry leading cluster solution such as MSCS, MC Service Guard, Veritas Cluster.		
3	The back up software should support backup to cloud like AWS/Azure		
4	The proposed back up solution shall have web based management GUI for easy administration/monitoring/reporting		
5	The proposed backup software should support both on premise and secure hosted backup solution		
6	The backup software should support either Front end Capacity based model or Application based model of product licensing		
7	The proposed backup solution should allow creating tape clone during or after the backup process for long term retention and archival		
8	The back up software should secure All communications between the different entities of backup over a secureTLS1.2channel		
9	The back up software should support NetApp Storage residing in cluster environment		
10	The backup software should support multihomed networks		
11	The backup software should support Oracle 12c version, SYSBACKUP user privilege for backup and recovery		
12	The proposed backup solution supports the capability to write up more than 8and upto 32 data streams.		
13	The proposed backup solution must support atleast AES256-bitencryption capabilities.		

Sl. No.	Specification	Supplier Response(Compliant/ Not Compliant	Remarks
14	The backup software should support Data Domain OS 6.1 and DD Boost3.4 libraries.		
15	The backup software should support Telemetry service to capture insights for better supportability, product best practices		
16	ThebackupsoftwareshouldsupportSchedulerservicewhichissimplified and easy-to-use web controls		
17	The proposed backup software should support easier schedule management, recurrence of back up jobs and fix conflicts using a single Scheduler wizard.		
18	The backup software should support a secure method of exposing RESTAPI for external/web based app/portals		
19	The proposed backup solution has in-built media management and supports cross platform device and media sharing in SAN environment.		
20	The proposed backup solution has certified “hot-online” backup solution for different type of Enterprise Databases and Applications		
21	The backup software should support Non Staged Granular recovery for Vmware and support the backup of Vmware snapshot to tapes		
22	The proposed backup software should use the same API for software and hardware deduplication		
23	The backup software should support backup to disk /VTL /Deduplication Device via Fibre channel or via high speed LAN		
24	The proposed back up software should allowed duplication either on the Application Server or the Backup Server or the target Device.		
25	The proposed back up solution shall support synthetic full backup/Virtual fullbackups.		
26	The proposed back up solution shall be able to back up data a cross firewalls with minimum ports		
27	The proposed backup solution shall support automatic skipping of backup during holidays.		
28	The backup software should support the option of prioritizing backups foreach schedule		
29	The backup software should support meta data replication and multi-site management from the same console.		
30	The backup software should support the backup of Virtual machine disk in parallel		
31	The backup software should support missed job execution		
32	The backup software should be capable to supporting 99,999backup sessions in day		

Sl. No.	Specification	Supplier Response(Compliant/ Not Compliant	Remarks
33	The backup software should be capable of supporting 1000concurrent sessions		
34	The backup software should be able to support maximum of 40 Million files per directory		
35	The proposed backup solution should support tape mirroring of the same job running concurrently with primary backup.		

15. Racks:

42U Rack				
Sl. No.	**Parameter**	**Specification**	**Supplier Response(Compliant/ Not Compliant**	**Remarks**
1	Rack Details	42Urackwith front and rear door, side panels, Door Branding kit, Adequate PDU(Minimum4 PDU per rack) for connecting servers, storage and networking equipment with complete load taking capability for the servers, storage and networking as proposed.		
2	Size of the rack and type	The Rack should best and ard rack in size for housing proposed equipment and from the OEM of respective servers, storage, tapelibrary and networking vendor as proposed.		
3	Accessories.	Adequate no of Cables and accessories like cableties, cable guides, stabilizer kit. Door branding kit, screws and ballast kit as required need to be proposed with each rack. Additionally bidders are requested to offer additional if any required for the solution.		
4		Baying Kit to join enclosures		
5	Other Requirement	Static Load Capacityofminimum1200 kg		
6		Rolling Load Capacityofminimum1000kg		
7		Minimum 65% of Open Perforation area on Front Door for air in take requirements of IT equipment.		
8		The Rack should comply to IP 20, providing protection for protection against touch and in gress of foreign bodies		

42U Rack				
Sl. No.	**Parameter**	**Specification**	**Supplier Response(Compliant/ Not Compliant**	**Remarks**
9		All interior components of the cabinets shall not have electroplated zinc coating to minimize zinc whiskers near active equipment.		
10		Toolless Cable Management ring should be capable of managing 50 Ethernet cables.		
11		Adequate nos. of1 U/2 Ublanking panel for 100% air sealing.		
12		Vertical Zero U Rack PDU should be within put cable length ofminimum2.5 meters IEC309 32 A P+N+E connector		
13		Each PDU should have minimum18 nos C13 and 3nos C19 socket for power distribution to IT equipment and should be mounted vertically in rear of rackoccupying0Uspace.		
14		Single Perforated Front Door with profile which shall have better air flow		
15		Split Perforated Rear Door for better clearance at rear side.		

16. Other References:

Sl. No.	Topic	Reference
1	LAN	Section G3-Technical specification of Hardware and Networking equipment and systems ofSRS (RAPDRP Part A- IT)
2	VPN/MPLSWAN	
3	Implementation Plan	
4	Cabling System and Component Specifications	
5	Mail / Messaging System	
6	Network Performance Analysis	
7	IPPBX	
8	Anti-Virus Solution	
9	Hardware for customer care center related equipment	
10	Spot Billing Machine	

11	Printers	
12	IDMS & Kiosks	
13	DR Center management	
14	Any other component not mentioned in TRS exclusively	

17. Metering, Billing & Collection (MBC).

An elaborate MBC solution suiting to the needs of the DISCOMs is expected to be customized by the IT Implementation Partner. The System has to be self-sufficient in all respects and should be able to meet all the latest industry standard functionalities to support DISCOMs' Revenue management activities and Integration with existing systems like spot Billing, Mobile Phone based Billing, Pre-Paid Metering, Revenue collection System etc.

Tentative but not exhaustive list of functionalities are enclosed herewith

Refer RAPDRP PartA(IT)– SRS-Section G2

The Commercial Database of Consumer is to be developed based on the Consumers Billing Database available with the Utility and the GIS based consumer and asset data base developed/being developed. The system to be developed and installed under this specification shall be capable of accepting the data as will be made available and capable of appending any necessary attribute etc. and performing the entire intended task. After the first installation, the database shall be updated online and taken into the system for routine functioning.

a. Thecommercialdatabasedevelopmentshallcoverthefollowingactivities-
   i. Development of Master File of consumer comprising of consumer's details including
   ii. Energy meter history as per Annexure-G of Section-G6 of this specification,
   iii. meter reading,
   iv. energy consumption,
   v. assessment,
   vi. payments and
   vii. other relevant data from the initial record and other relevant records to be provided by Utility.
      - Data model should support complex billing operations such as single bill for a customer having more than 1 connection and other such operations which require customer information at various layers.
      - In case of consumers on computerized billing system, data shall be provided in the form of soft copy as far as possible.
      - In case of consumers billed manually or new connection, data will be provided in the form of manuscript as per standard card code system.

b. Development of well-designed layout/formats for Master Information Data in softcopy for easy reference and access, to be approved by Utility. The layout/formats will be properly defined and documented for reference to facilitate Data Management and print out as and when required.
c. Updating of consumers' master file on the basis of the transaction advice from respective source from time to time in respect of energy consumption, payment made and any other changes to affect required modification in the Master Data.
d. Undertaking consumers' master file listing in the prescribed format, compilation of corrected master file at the initial exercise of master file creation as detailed against 'a' ,'b' and 'c' above, incorporating such corrections to consumers' master file on subsequent repetitive processing as detailed against item 'c' above, so that at any time Masterfile of consumers and listing of such corrections / additions represents the correct status of consumers file record for reference.
e. Utilityshallbeprovidingtheexistingcustomerrelatedinformationasavailableon records for starting the billing activity. In the Commercial Database available with Utility each consumer is allotted a Service Connection Number and Book Number. While developing data base care is to be taken

that each consumer is allotted unique identity number (generated during consumer indexing) so that with the help of that identity number it should be possible to identify the Consumer, Feeder ,Distribution Transformer and the Substation feeding the consumer.

f. All data related to a consumer must be captured in database v.i.z. Consumer S.C Number, premise number, e-mailID, Name, Meter number and make, CT/PT ratio, date of installation, date of testing, name of personnel employed for checking and sealing, billing address, supply address, phone number, customers tariff category, contracted load, specialconsumerstatus(likehospital,waterworks,govt.officesetc.)etc.

g. GIS based index data base has structured customer information on GIS based map with electrical system on the foreground and all the Consumers are being coded and segregated 11 kV feeder wise and Distribution Transformer wise. In the Commercial Database to be developed, care has to be taken that Consumers are segregated Distribution Transformer wise,11kV Feederwise and 33/11kV Substation wise so that there is no problem in Energy Accounting. Moreover any change taken place in customer information related to electrical network equipment due to addition/modification of network in the base GIS system, the commercial database shall be automatically updated.

h. The agency developing the system software shall provide with easy and convenient platform to integrate his software system with indexed Geographical and Electrical Database. The two systems (i.e. Customer indexing cum as set mapping system and billing system software) have to work in total unison such that any revision of data in one of the system should automatically update into related information in the other without any conflict. Wherever there is limitation on account of any cross system interaction, it has to be resolved and debugged by the supplier to the complete satisfaction of Utility.

i. System must be able to support operations for variety of consumer like residential, industrial, commercial government, agriculture etc. History of consumption and payment for every consumer must be maintained even after account is closed or interrupted for a period of 10 years or as maybe mutually decided with WESCO.

j. Complete data of the entire system for the past 2 years must be available on server. Data of prior period must be available on external media, which can be loaded on server as and when needed.

k. The Commercial Database to be developed should be capable to interface with the Geographical and Electrical Database with the S.C. No. of the consumer being the link key between the two databases. Provision should be there that interfacing of the database should be possible with any other system that may be developed at a later stage.

Module : Metering

Objective: An Effective meter reading system would enhance the effectiveness of the measurement process. This would include accurate metering for all customers and tapping revenue loss through the identification and handing of exceptions. **System Boundary:** From: Consumption detail capturing To: Providing final reading					
Specification Metering					
Requirement ID	Functionality	Explanation	Criticality	Response	Comments
M1	Collecting meter readings in the metering database from remote meters	All the input points to the circle and feeders & related distribution transformers are having electronic meters. The data of all such meters will normally be downloaded on a server located at Subdivision office. The system should be able to communicate with Sub-division office server through dial up line or other communication devices(including data transfer through removable media.)The system should also be capable of interfacing with Spot billing devices and MRI data for uploading such meter readings including consumer meter readings. The detail specification of system meter data acquisition is in separate chapter as 'datalogger'	Vital	C/ER/F/ CR/NC	

M2	Data Validation	System should provide data validation checks to minimize data entry errors. It should incorporate user supplied logics to check variations in consumption and generate exceptions. After data entry, the system should generate an Exception Report for non reading of meters due to any reason. A typical list of such exceptions has been listed at Annexure-F of Section G-6. It shall also highlight possible inconsistencies in the metering data. After handling of exceptions by the respective officials, the system should be updated with the result of exception handling. While validating if the meter reading found low / unacceptable based on earlier readings/trends the system should issue a work order for checking and replacement of meter. If the work orders are not closed with valid reason system should escalate the issue till the same is resolved	Vital	-do-	-do-
M3	Data Review	The system should provide the facility for the designated officials to review the metering data as per utility defined criteria. In case any discrepancy is found, the system will allow the data to be edited, with proper access rights and audit trails.	Essential	-do-	-do-
M4	AMR Compatibility	The system should be able to interface with Automatic online Meter Reading devices. System should be capable to schedule and collect automatically readings from online connected consumer meters / Distribution Transformers meters through automatic meter reading system. The system should generate exception in case meter reading found unacceptable after validation check	Essential		

M5	Capturing Meter reading Data	The system should be capable of capturing meter reading data from a Meter Reading Book, handheld computers/CMRI used for spot metering & billing for uploading and downloading the data. System should be capable to upload and download the data for a given set or group of consumers to CMRI/HHC automatically. System should also keep log of CMRI Device/HHC assigned to meter reader.	Vital		
M6	Validations for the spot metering and billing data updated	The system should be able transfer or update the meter reading validation logic to the MRI and spot billing machines. The system should have the flexibility of validating the data uploaded from the meter reading instruments. The validation would include restricting the customer data uploads to those that were indicated in the meter reader's schedule.	Essential		
M7	Prohibiting the wrong entry	The system shall also have provision for prompting the Meter Reader at the time of entering wrong meter reading values in the spot billing machine.	Essential		
M8	Meter reading plan generation	System should generate meter- reading plan for day / week / fortnight by meter readers and provide it to the respective authorities. For generating meter reading plan system should take care of no of meter readers available with the customer and their productivity for coverage of all meters before due date. The business logic shall be provided by owner and owner should have a flexibility to modify the same. After generation of plan the same shall be sent to respective offices by e-mail/other mode, so	Essential		

		that the meter reader can download the site/premise addresses of the meters to be read on that day. The system should be capable of- i) Assigning individual MRIs to individual Readers to track their performance. ii) Generation of optimum route plan using the capabilities of the GIS and based on reading jobs (including re-reads if any) to be read in a given cycle in a given area/route to maximize the productivity of meter readers. iii) Optimization of meter plans whenever a new connection is "inserted" in a route, or an existing connection is disconnected and "deleted" from the route. iv) Reading plan should include disconnected connections also based on logic, and should exclude the same based on instruction from authorized user; reader should not be able to know from MRI whether a particular connection on his reading plan is supposed to be live or disconnected, for the purpose of tracing the connections wrongly marked disconnected where meter may still be at site.			
M9	Monitoring meter reading plan	The system should make it necessary for the meter readers to upload all the meter readings according to the itinerary generated within the timeframe stipulated by the utility. Otherwise exceptions should be generated and further meter reading can be entered only after clearance	Essential		

		from specified authority. The system should track and generate the exception reports, for each meter reader to establish performance measures and determine deviations if any. It may include No. of meters planned, no. of meters actually read per day, no. of wrong readings, unread meters by reason etc.			
M10	Monitoring Customer exception	The system should be able to track customer behavior in terms of exceptions. For example: The number of times a customer figures in the list of exceptions.	Essential		
M11	Supporting meter reading on trust	The system should also have the facility if desired by utility to enter the meter reading as specified by the customer by telephone/ fax/ web portal and record that the same is customer-specified. All customers who provide a reading on trust, should be inspected after a Utility specified time period. This would mean that a customer providing a reading on trust would be inspected once every 6/12 months for instance.	Essential		
M12	Overdue alert	In case a meter reading becomes overdue (Utility specified criteria),the system would generate the necessary exceptions and alerts.	Vital		
M13	Accepting change in metering cycle	The system should be in a position to cater to changes in the metering cycle. Metering in certain cases maybe TOD, hourly, daily, fortnightly etc.	Essential		
M14	Capability to store data for a specified	The system should keep past metering data online for a period specified by the Utility & SERC guidelines from	Vital		

	period	time to time.			
M15	Interfacing with spot billing and MRI instruments	The system will support data downloading to and uploading from handheld devices used for Spot metering & billing and MRI. The devices would provide information about the meter number, customer code, meter reader's employee no, meter reading with date and time stamping, and billing amount.	Vital		
M16	Meter reading for temporary connections	The System should be capable of accepting opening, closing and intermediate meter readings for temporary connections for generation of bills for such connection.	Essential		
M17	Final meter reading for closure of connection	For all kinds of disconnections (whether a customer requests for termination of connection or utility disconnects due to non payment), the system should accept the terminating meter reading (which will be out of cycle in most cases) for generating the last bill.	Essential		
M18	Lifecycle monitoring and testing plan for meters	System must be capable of capturing complete meter history throughout meter's lifecycle, starting from arrival in stores to type, Make. Model, Batch, Catalogue Number of meter, its place of installation, cycle and record of calibration/testing till it is being scrapped or destroyed. System must be capable of capturing data like ordinary meter, electronic meter etc. System must be able to identify the meters, which are due for mass replacement or scheduled testing/calibrations and generate a work order for action by field staff. It is desirable that system should be able to interact with	Essential		

		meter testing devices for obtaining test report.			
M19	MIS generation	System should be capable to monitor and track the following: Meterreader's performance, Comparison of input versus expected consumption, variance in consumption for consumers etc.	Vital		
M20	Tracking meter location	Current location of meter must be tracked i.e. in stores, under testing, at consumer premise, under overhauling etc. Data must be captured at appropriate locations and point of time to track the meter.	Essential		
M21	Tracking meter status	The system will track the current status of the meter. Various options would include Correct Meter, Stuck-UpMeter, Sluggish Meter, Door Lock etc.	Vital		
M22	Tracking meter/meter boxes Seals	Tracking& reconciliation of meter seals i.e. date, type no. of seals, sealed by condition of meter etc. including meter boxes.	Essential		

Module : Billing

Objective: A comprehensive billing system will ensure that the utility efficiently bill their customers for the services rendered. It should support the continuous billing to reduce the outstanding. Ensure the timely and accurate billing. The system will support the complaints handling functionally by providing short turn around times for billing related customer queries.

System Boundary: From: Accepting Consumption data To: Providing reminder letters **System Functionality**: This system should broadly cover functions relating to generation, printing and issue of bills to the consumers. Specifications for various billing types, tracking of reasons for deviations from normal billing, billing logic flexibility etc. are some of the features that the system should address.

Specification Billing

Requirement ID	Functionality	Description	Criticality	Response	Comments
B1.	Unique Bill No	All bills generated by the system should be given a unique number	Vital	C/ ER/F/ CR/ NC	
B2.	Format of bill number	The logic for defining the bill number would be flexible and provided by the client. For example the system should be capable of generating bill numbers that are reflective of the Section Office, Subdivision, Division etc that the customer falls under. It should also capture the customer category and the billing month.	Vital	C/ ER/F/ CR/ NC	
B3.	BillCalculation - Billing Logic flexibility	The Utility would provide the billing logic for generation of bills. This calculation logic will be flexible and the utility should be able to revise the billing logic from time to time depending upon the modifications in regulations, tariffs, etc. It should be possible to make these changes from a central location. It should be possible to manually modify the billing logic on a case to case basis, with alerts and	Vital	C/ ER/F/ CR/ NC	

		within specified limits. The system should follow the same for computing the final bill amount and should generate bill in soft and hard forms for the all type of requisite customers with certain pre-defined periodicity. The periodicity may also vary from generating continuous bills for spot billing to bills once a year for particular type of customers like agricultural customers. The system should have the flexibility of defining the periodicity in bill processing. The system should have the capability to generate the bills either in batches or individually. System should also accept billing logic for consumer purchased meters. Suitable rebate as per rule be provided for consumer purchased meters. System should have provision of - i) Auto-credit of penalty specified by SERC for Utility in case of deficiency of service to the consumer ii) Putting a certain bill amount under deferral due to stay order from court till the matter is decided.			
B4.	Transfer in billing logic	System should also support prepaid metering and billing system, if implemented by utility later on and should permit seamless transfer of existing customers from- i) post-paid to prepaid regime and back ii) Unmetered to metered regime iii) kWh based billing to KWh & kVArh based billing regime and back	Essential	C/ ER/F/ CR/ NC	

B5.	Meter data validation	The system shall be capable of identifying meter tampering data as per utility defined criteria and generate flags for operator intimation and further investigation. The billing system shall be capable of identifying faulty meters and preparation of bills considering a defined algorithm for estimation of consumption during such periods of meter faults. The bills shall indicate the estimated consumption separately. System shall also incorporate multiple meter changes in a single billing cycle, properly accounting old meter final consumption based on final reading (or assessment if functional reading is not available)	Vital		
B6.	Bar code generation	System should be capable of automatic generation of barcode and printing on the consumer's bill UsingCode-39 or any other Universal standard; capable of generating Alphanumeric and all the special characters available on 'Microsoft-Word', Additional Capability to generate output in 'local language' script will be preferred.	Vital		
B7.	Billing logic download	System should be capable to download the billing logic to CMRI/HHC to facilitate spot billing at consumer premises using HHC/CMRI as and when required.	Vital		
B8.	Bill printing based on dispatch	System must be able to automatically select and print those bills together in a desirable sequence for ease of	Essential		

	sequence	distribution, which are under same reading cycle/group, convenient for walking order of meter readers/bill distributors.			
B9.	Group billing	System should allow for generation of common bill for a set of consumers with same due date. The system should also have provision for generation of bill of multiple premises on a single bill for a single customer, if the customer has opted for the same.	Essential		
B10.	Bill printing flexibility	System must support bill processing and printing either at workstation location or at the base billing center.	Essential		
B11.	Use of pre printed stationary	System must be able to print the bills either on pre-printed stationary or plain paper in Hindi/English/Local language as per directions of Utility.	Vital		
B12.	Interfacing with manual billing	The system should have the flexibility of capturing inputs manually to update the customer database on bills that have been manually generated, with are as on for the same. Such updates should be limited to specific logins.	Vital		
B13.	Bill on demand	The system should be capable of generating bills on demand by the customers. The system should have the provision of generating duplicate bills on demand from the customer - and have the provision for accepting payment details for the same. The system shall have provision to print duplicate bill of any past bill up to last 3 years (applicable after the software is rolled out)	Essential		

B14.	Bill correction/ amendment provisions	The system should have provision for Bill correction/amendment manually to update/ modify the customer billing database, with a reason for the same. Such bill amendments should be limited to specific logins. The system shall employ separate accounting process for bill amendments, which results in reversal of sales (Unit and Rs) booked (bill raised) in past financial years, i.e. prior to start of current year.	Essential		
B15.	Change of billing cycle	The system will have the capability to change billing cycle of a consumer. The changes would include - shifting to another cycle and increasing or decreasing the frequency of billing.	Essential		
B16.	Interfacing with special drives	If there is some special scheme for payments (e.g. Installments), then the system will generate the bills taking into account the special scheme provisions. Also, there would be codes for all the Schemes, so that the system can track their usage. There would be codes for all the Schemes so that the system can track their usage. The system will keep a record, as to who authorized the scheme (e.g. installment) and capture the details of the scheme.	Essential		
B17.	Options for level payments	System should have options for level payments wherein the customer can pay a fixed amount per month. In such a scheme, system should also provide for balancing the charges at the end of the year for any variations between the calculated amount(Fixed amount) Vs the actual	Desirable		

		charges the customer has incurred.			
B18.	Penal Billing for unauthorized use of electricity	System should have provision to compute penal billing for unauthorized use of electricity, as per Electricity Act, and based on parameters defined by SERC a) Assessment based on sanctioned load/ connected load/ MDI b) Assessment based on error in meter accuracy due to tampering c) Penal tariff for theft/ misuse.	Vital		
B19.	Linking consumer to appropriate tariff	The system should link the customer to the rate applicable to his category. The rate applicable is calculated on the basis of fixed charges, consumed energy, capacity (power consumption limit), taxes applicable, subsidy or support from the government, etc. System shall also have provision to account for retrospective changes in tariff / discount / subsidy announced by Govt. with effect from backdate. In case of subsidized customer the system should calculate amount of subsidy payable against each bill and if utility want the subsidy amount can be printed on the bill for information of customer.	Vital		
B20.	Inclusion of past dues and surcharge	The system should calculate other dues for the customer (e.g. late payment charge, electricity duty surcharge, assessed amount, etc) and add them to the regular bill amount. If there are past dues, the system should	Vital		

		calculate both the past dues and the fines on past dues as applicable. The system should allow flexibility to define and modify the logic for fine/penalty calculation for different types of arrears as per the prevailing norms of the utility. If past dues are there the generated bill should include past dues. In case of any post facto extension of due date, system to have provisions to automatically waive late payment surcharge.			
B21.	Management of Security Deposit (SD):	The system should have provision of Managing Security Deposit (SD) like: i.) Auto-debit of incremental SD in bill(s), eg, in case of load enhancement ii.) Refund of SD by adjustment in final Bill iii.) Interest pay out on SD through auto-debit in bills or lump sum pay out separately iv.) Adjustment of SD in prepaid charges for any consumer shifting from post-paid to prepaid regime	Essential		
B22.	Billing with pre payment credit	If there is any credit on account of prepayment, adjustment etc., the system should be able to adjust the credit against the amount payable for the month and generate a zero or a negative bill.	Vital		
B23.	Estimate billing	As and when the metering data is validated in the system, it should be capable to generate bill under the normal	Vital		

		billing cycle. In case of meter data is not available the system should generate an estimate bill based on the past consumption pattern of the customer. It shall also be possible to generate Estimate Bill for theft/enforcement cases. The system should also provide for change in the estimation logic that may happen from time to time. The system should incorporate the estimate for consumption from the metering module.			
B24.	Reasons for estimate billing	The system will have a list of all standard reasons for estimate billing. The list will be compiled based upon the utility and SERC guidelines, which may change from time to time. The system should be capable of generating bills for all instances of exceptional readings. The scenarios under which exceptional readings are taken are temporary connections, voluntary termination, forced termination etc. The system will allow the bill amount to be modified by the designate authorities through their login ids only. All such changes alongwith the corresponding login ids will be tracked by the system.	Vital		
B25.	Electronic dispatch of bill/ availability of bills on internet portal Of utility	The system should be capable to dispatch the generated bill electronically to customer/payment portals to which customer is registered if desired by customer. The bill in actual format must also be available on utility's internet portal for customers. System must be able to inform customer regarding new bill along with due date & amount via SMS automatically. The system should allow generation of reminder letters at predefined intervals	Vital		

		before the due date -over the web/ mobile phones/paper formats.			
B26.	Discontinuing billing after dismantling	The system should have the provision of stopping the generation of bills and taking the arrears as bad debts, after a Purchaser specified period of time,say6-12months after dismantlement.	Desirable		
B27.	Billing for temporary connections.	The system should have the provision of preparation of Temporary Connection Energy Bill, with DISCOM defined Category and Charges. Provision for- Final Bill Proportion Fixed amount calculation (In case of first bill) Amount Shifted to next bill (if next bill is prepared in same month) Debit/Credit Adjustment (Unitor Amount) The system should have provision for automatic job creation for disconnection and final billing of temporary connections one day prior to the expiry of the duration for which the temporary connection was granted. The system should also have option to extend such temporary connections based on utility defined authorization.	Vital		
B28.	Creation of monthly ledger	The system should provide the monthly ledger of the assessment and realization.	Vital		

B29.	Ledger adjustment	The system should have the provision for Debit/Credit Adjustment in ledger.	Essential		
B30.	Final reconciliation	The system should have the provision for Final Bill Reconciliation, in case of permanent disconnection and provision for final amount adjustment.	Essential		
B31.	Monthly report generation	Module can close Ledger monthly and generate assessment and realization report.	Vital		
B32.	Last bill generation	In case a customer requests for termination of connection, the system should accept the terminating meter reading(which will be out of cycle inmost cases) for generating the last bill.	Vital		
B33.	Provision for holding bill printing till checked	System should have the provision of not allowing to print any bill of a cycle unless cleared by bill quality check group. System shall have post billing filters to out sort abnormal bills based on logic, so that such bills are not printed/sent to consumer by any mode.	Vital		
B34.	Bill distribution routeplan generation	The system should have provision to generate optimal bill distributor route plan based on bill distribution jobs in a given area in a given cycle.	Desirable		
B35.	Enforcement and Legal Module: Logging of leads	System shall have provision to log leads of theft/ misuse by: - Creating automatic leads based on consumption analysis and tamper analysis	Desirable		

		- Accepting lead through mail, website, phone calls, call centre or any other mode - Capturing the details of the lead contributor person, whether employee/outsider			
B36.	Enforcement and Legal Module: Lead processing	The system shall have provision of lead processing-workflow and life cycle tracking for: - Assessment billing - Public Hearing and bill revision - Payment and Settlement - Escalation& Legal proceedings - Recovery of installments - Case closure	Desirable		
B37.		Spot Billing System -			
B37.1	Downloading of data in spot billing system	The Spot Billing system shall enable meter reading activities by transferring relevant consumer information database from Billing system, like service numbers, address, area code, meter number, phase, load, MF, old meter reading, old status, category, arrears if any etc.	Vital		
B37.2	Uploading of data in spot billing system	At the end of data collection and billing operation in the field, the information recorded in the spot billing machine should be uploaded into the Base Billing system for updating master database in the system. The	Vital		

		information would contain the service number, present meter reading, present status of the meter, billed date and time, units consumed, average units, billed amount, due date, disconnection date etc.			
B37.3	Billing logic in spot billing system	The Spot Billing software to be resident in the HHE shall be based on the existing billing logic and algorithms of the utility.	Vital		
B37.4	Tariff revision cases	The HHE should be able to calculate the tariff rates accordingly with the previous and present rates during the assessment period, so as to issue the on date calculated demand to consumers under tariff revision period including number of days,slab rates etc.	Vital		
B37.5	Skipping of meter reading entry	The HHE should prompt for entry of present meter reading. If meter reading is skipped, average/units consumed for previous month from the master shall be calculated/retrieved and units for billing shall be displayed.	Vital		
B37.6	Entry of meter status	The HHE should prompt for entry of meter status and display of calculated units/Avg. Units(Avg. units is to be retrieved from the master data)depending upon the meter status.	Essential		
B37.7	Billing with charges / adjustments	The HHE shall prompt for any other adjustments/charges depending on the category of the consumer. Net bill is to be calculated after adjustment of above charges and should be displayed and prompt for	Essential		

		printout shall be given.			
B37.8	Error checking	Extensive error checking shall be provided to assure data integrity during communications between the HHE and the PC.	Vital		
B37.9	Validation of meter reading data	Field validation for meter reading shall be ensured if the readings are beyond a predefined range and software will have provisions to enter remarks in such cases of abnormality.	Vital		
B37.10	Printing of summary report	Spot Billing system would print the summary report with HHC serial number, which contains the consumer file downloaded to the unit, total number of services, services billed/unbilled, total amount etc.	Desirable		
B37.11	Password protection	HHE shall have two levels of Password Protection- Supervisory level for functions of upload, download, time setting and other supervisory functions and Meter Reader level for starting and closing the meter reading.	Essential		
B37.12	Event logging	All events should be recorded in the event file in HHE. The event details should be downloadable for analysis.	Essential		
B37.13	Menu driven modular format	The spot billing software shall be user friendly, menu driven, structured and modular format for flexibility (Easy changes / Up gradation etc.)	Vital		
B37.14	Time stamping of logged data	Data Logging in the spot billing machine shall be date and time stamped.	Vital		

B37.15	Provision for enhancing the functionality	There should be a provision for enhancing the functionality of the software by adding additional features.	Essential		
B37.16	Time setting of HHE	The HHE shall have the facility to get its time set from Billing system only with proper security and password authentication.	Essential		

Module : Collections

Objective : The system should provide different payment and information channels to customers and own staff to improve customer convenience for payments and enable collections for the energy billed, and a shorter metering-bill billing-collections (MBC)trade cycle **System Boundary**: **From**: Capturing payment details **To**: Generation of disconnection and dismantlement lists					
Specification: Collection					
Requirement ID	Functionality	Description	Criticality	Response	Comments
C1	Decentralized payment processing & centralized reconciliation	System must be capable of handling centralized or decentralized payment processing. And System must be capable of centralized reconciliation of the collection.	Vital	C/ ER/F/ CR/NC	

C2	Linking payment to logging id	The system should capture all the customer and payment details as specified by the Utility time to time. All payments should be associated with the login-id of the personal receiving them and the collection center codes at which they were received. All collections should be made against specific bills/forms to enable reconciliation at a later stage.	Vital		
C3	Mandatory reason code	In all Instances of collections without bill/ form the system should make it mandatory for the user to specify a reason from the predefined reason codes embedded in the system and defined by the Utility time to time.	Essential		
C4	Code based Classification of collection	All collections will be classified against standard codes of payments that would be specified by the Utility from time to time.	Vital		
C5	Receipt generation	The system should generate a receipt whenever money is collected. Each receipt should have a unique receipt number. The system will allow payments to be collected under the payment categories indicated by Utility.	Vital		

C6	Adaptability to different mode of collection	System shall be capable to receive payments made by the consumer in either of the following modes: - Cash/ Cheque/ Bank Draft/ Credit Cards/ Debit Cards/ Internet Payment Gateway or Payment made by direct debit from bank accounts on authorization by the consumer (ECS). Any other mode as may be specified by Utility from time to time. In certain cases (e.g. Advance Payments) collections can be accepted without the bill as well. System should have support of accepting payment through a single cheque against multiple bills and keep proper track against respective bills. Further, the system shall also allow the consumer to pay one single bill through multiple modes i.e. through multiple cheques of different banks, by cash & cheque etc. The payments made by the consumers are to be acknowledged and accounted for in the respective databases. For payment made by the consumers at Collection Counter through Cheque/ Bank Draft computerized acknowledgement shall be issued to the consumers. System must be able to generate & send SMS automatically to customer for every payment received.	Vital		

C7	Handling of cheque payments	The system should have following functionalities : a) Holding recovery proceedings based on cheque submission, but recognition of payment on cheque clearance only. b) In case of cheque dishonour - i) Reversal of any payment recognized by the system ii) Levy of handling charges iii) Generation of Notice under Negotiable Instruments Act iv) Blocking of further payment by cheque till a defined timeframe/logic with appropriate message on bill for same.	Essential		
C8	Daily reconciliation of cash and bank	The system should generate a daily total for the receipts issued for the day. This would enable the daily reconciliation of the cash collected with the amount entered in the system as 'payment received'. The system should also capture all bank remittance details. At the end of a period, the system should reconcile them with the bank statements.	Vital		

C9	Acceptance of part/ advance payment	The system should have the flexibility to accept full, partial or advance payments. The system should also have the facility to centrally change these settings from time to time (e.g. - not accepting partial payments during the last few months of a financial year).	Essential		
C10	Interfacing with special drives	In certain cases (eg during special collection drives, collection by spot billing agent etc) collections are made in the field and receipts issued there. The system will have the provision for accepting the collections and receipt details for such field collections.	Vital		
C11	Generation of reminders/ disconnection notice	The system should allow generation of reminders by SMS/ letters at specified dates - before the payment due date, and notices for disconnection, dismantlement.	Essential		
C12	System ability to keep track of cancelled receipt	System shall be capable to cancel receipt at cash counters due to wrong punching etc. The details of cancelled receipt to be kept in the system and the same may be printed on the new receipt also. System should also provide to reverse the payment applied to a particular account in case errors are detected at a later stage, e.g. payment getting applied to a wrong customer.	Essential		

C13	Finance & Accounting	The system should have provision for - i) Automatic creation of books of accounts based on : -Balance Sheet and Profit & Loss Statement as per GAAP and Indian Companies Act 1956 - Annual Revenue Requirement, based on Electricity Act 2003 read in conjunction with SERC regulations ii) Meter to be treated as asset in ARR (may be treated as consumable material in other books of accounts) iii) Different payment settlement logic for various components of payment received from the consumer: - Energy Revenue (a) Revenue as per tariff : i. Subsidy/Discount outside normal tariff structure ii. Penal tariff in case of theft / misuse (b) Electricity Tax - Non-energy revenue (a) Charges for various services : Service Tax (b) Late Payment Surcharge (c) Penalty payout to consumer in case of deficiency of service (d) Interest payout to consumer on: i. Security Deposit ii. Advance Payment - FIFO/LIFO settlement logic specific to Utility's requirements, on the following buckets : (a) Arrears : i. Prior to certain period, inherited by Discom from SEB as legacy ii. After the certain timeline, as accumulated by Discom (b) Current Demand iv) Payment settlement logic should take care of the	Essential		

18. Other Applications and Customer services.

Objective: The system should improve the customer service by processing and resolving customer requests/queries/complaints in minimum possible time by taking up it at appropriate place and level.			
Module domain			
From:	Receipt of customer requests /queries/ complaints		
To :	Closure of complaints and intimation of the same to the customer		
Specification Customer Services			
The CRS will provide customer care using all subdivision's latest consumer and network data using latest technologies. The prime data input for the CRS will be as follows-			
a	Consumer related all sub-division information	Via	Each sub-division's daily working
b	Latest Network information	Via	Each sub-division latest Network data
c	Feeder Shut down,Break down, Faults, Alerts	Via	CRS operator or SCADA
d	Complaint/Grievances registering, logging and assigning	Via	CRS operator
e	Attending the complaint	Via	Line party/Gang
f	Attending of Grievances	Via	Concerned subdivision officials/modules
g	Feedback or receiving the solved information	Via	CRS operator

Type of Complaints that shall be received include -

S. No.	Type of Complaint / Grievances	Nature of Complaint	
1.	Voltage related	Voltage High	
		Voltage Low	
		Dim Supply	
		Voltage Fluctuation	
2.	Supply Failure related	Supply failed – Individual	
		Supply failed – Total Area	
		Supply failed – One Phase	
3.	Transformer related	Transformer– Cable / Lugs burnt	
		Transformer – Oil Leakage	
		Transformer – Sparking at Pole	
		Transformer – Smoke /Flames	
4.	Line related	Line Snapped	
		Line – Tree branches touching	
		Line – Bunched / Twisted	
5.	Pole related	Pole – Rusted / Damaged	
		Pole – Fell Down	
		Pole – Leaning	
		Pole – Current leakage in pole	
6.	Services connection related	Service connection–Wire Damaged	
		Services Connection – Wire Broken	
		Services Connection – Wire Loose	
7	Billing related	Excess billing, wrong meter reading	
8	Meter related	Defective or damaged meter	
9	New connection	Getting new service connection,	

S. No.	Type of Complaint / Grievances	Nature of Complaint	
10	Disconnection / not in use	Disconnection of supply / not in	
11	Attribute change	Attribute changes i.e. location,	

The various other services in addition to technical complaints as mentioned above that shall be extended by the customer care center to the customer of DISCOM are mentioned below. The list is just indicative.

1) Customer Information-

Providing information to customer queries relating to metering and billing data. Information about how to avail various customer services offered by DISCOM, etc.

2) New Services Connection-

Provide status and information for new service connection.

3)Handle Metering & Billing related and other Complaints-

Receive and register all complaints relating to metering, billing, disconnection, dismantlement etc., forward the registered complaints to the respective office of DISCOM for timely redressal. Follow up until the complaint is successfully resolved.

4)Handle Request-

Accept and register various service request relating to status of title transfer, change of consumer data, change of contracted load, energy theft enumeration, line shifting, etc. Forward the registered complaints to the respective offices of DISCOM for timely redressal. Follow up until the complaint is successfully resolved.

Module : Centralized Customer Care Services

Requirement ID	Functionality	Description	Criticality	Response	Comments
CC1.0		**General Features-**			

Requirement ID	Functionality	Description	Criticality	Response	Comments
CC1.1	Establishment of single window computerized customer care center	The specification is for establishment of a centralized and computerized customer care center with single window operation equipped with latest technology &multi skilled customer service representatives. The one point contact service relieves the customer from the inconvenience of visiting or contacting different utility offices. In addition to Complaints received online through Telephone, email, fax, letters and IVR system, many customers may choose a personal visit and therefore the Customer care Centre set up to address their grievances, must be equipped with basic amenities, clean environment and manned by trained personnel, who should be sensitive to customer needs.	Vital	C/ER/F/ CR/NC	
CC1.2	Main features	• Easy to remember and easy to access Telephone number like 1912 with multiple lines • Available 24-hours a day,365 days a year. • Multi-lingual if required (Hindi, English, any regional language) • Multi-Skilled Customer Service Representatives • Single touch-point for no supply, billing complaints, fire & shock complaints, all other queries and assistance etc.	Vital		
CC1.3	Link of CC Centre to maintenance staff	The Customer care centre should be linked through mobile SMS in a "closed user group" to breakdown staff / mobile maintenance vans. Immediately upon receipt of a no-supply complaint, an SMS will be sent by CC centre to the breakdown staff/van for fault restoration. After restoration of the fault, the breakdown staff will close the complaint at the CC centre.	Vital		

Requirement ID	Functionality	Description	Criticality	Response	Comments
CC1.4	Seating capacity	Initially the centralized CC centre may be established with 2 to 4 seats, but should be further expandable as per the requirement of utility.	Desirable		
CC1.5	Availability of required functionalities like billing, consumer indexing etc. on agent desktop	The CRM infrastructure shall make use of the existing applications in such a way that the required functionalities are available on the agent desktop in the following fashion :- 1. The existing screens, features & functionalities of the Billing, Consumer Indexing and Asset Mapping & Customer Care Solution shall be popped up appropriately. The system shall have the scalability so that any change, if required can be done free of charge in 48 hrs time. 2. For the data, which is generated & maintained in the CC Centre itself such as call center performance, voice recording etc., the local database will be accessed. All other information like billing, collection, other customer service functions will reside over central server.	Vital		
CC1.6	Provision of read access to CC centre staff for various database tables	The utility shall provide read access to various database tables related with Computerized Billing, Consumer indexing and Asset mapping (if any). The agency shall be responsible for designing, procuring and installing necessary software and hardware for accessing the same.	Essential		
CC1.7	Design of CRM application by bidder to suit utility's requirement	The bidder shall design different CRM application for meeting the requirements of its agents in consultation with utility. This application should be fast, flexible and efficient enough to meet allthe requirements of customers' queries. Typically such an application shall display customer's personal profile, product / facility profile, billing and payment profile besides the answers for their queries. The bidder shall further add new features to be installed at CRM application, if so desired by utility free of charge within 7 days of the request.	Essential		

Requirement ID	Functionality	Description	Criticality	Response	Comments
CC1.8	Use of incoming as well as outgoing calls	The CC centre will provide facility not only for receiving calls, but also outbound calls. The Agents would be asked to make outbound calls for informing customers about the various power supply positions, payment reminders etc.	Essential		
CC2.0		Infrastructure			
CC2.1	Workstation dimensions	The workstation for each agent should meet minimum requirement of 36”x24” table size with partition. The agent seats should be placed at sufficient distance so that conversations are not overheard. Each agent should be provided with a standard and convenient seating arrangement / chair.	Desirable		
CC2.2	PC & communication facilities at workstation	Each workstation should be provided with Work station PC along with Telephone Instrument with good quality handsets of reputed brands with options like voice switch, background noise cancellation etc. Option of using headsets should also be available.	Essential		
CC2.3	Public conveniences & ambience	The CC centre environment should be pleasant and refreshing. The lighting should be soothing and air-conditioning up to human comfort level. Call center should have its own pantry and clean and tidy toilet.	Essential		
CC2.4	Sound proofing	The work atmosphere should be noise proof to avoid disturbances from external sources.	Essential		
CC2.5	Fire fighting equipment	The infrastructure should be provided with fire fighting equipments to avoid any disasters.	Essential		
CC2.6	Inter- connectivity of workstations	The workstations will be connected to each other through a LAN (Local Area Network) connection.	Essential		
CC2.7	Space to accommodate Technology Equipments	There should be separate and adequate space to host technology equipments, which must be safe, secure and accessible to administrative use only.	Essential		

Requirement ID	Functionality	Description	Criticality	Response	Comments
CC3.0		Technology -			
CC3.1	Voice logger & CTI server	It should be Voice logger driven, CTI Server based Customer care Center with real time data update. It will act as an interface between the customer and the Utility operations in the entire supply related complaint handling processes. It should use a wide variety of latest technologies to allow them to manage the large volumes of work that need to be managed by the customer care centre. These technologies will ensure that agents are kept as productive as possible, and that calls are queued and processed as quickly as possible according to the desired levels of service.	Essential		
CC3.2	High-Tech facilities	The centralized Customer Care Center consists of the following components. The components shown are logical blocks, these components can reside on single server or span across multiple servers. 1. Call Switching Equipment (Private Branch Exchange) – Soft PBX / switch based PBX 2. IVRS (Interactive Voice Response System) / Fax on Demand 3. CTI (Computer telephony Integration) - Screen pop-up 4. Automatic Call Distributor 5. Dialer 6. Voice Logger 7. Reporting 8. Call Monitoring and recording 9.CTI Remote monitoring capabilities and remote logging facility 10. Customer Relationship Module (CRM)	Vital		

Requirement ID	Functionality	Description	Criticality	Response	Comments
CC4.0		Call switching Equipment / PBX :			

Requirement ID	Functionality	Description	Criticality	Response	Comments
CC4.1	PBX features	The PBX system on the incoming trunk side should support both Analog and Digital lines (ISDN PRI). The capacity on the trunks and extensions shall be as per the size of the call center. The PBX should have all features of an advanced PABX System and should be CTI and IP enabled. The PBX should have the following features :- Call Transfer, Conference, Call Pickup, Call Monitoring, Call Recording, Call Hunt Groups, Direct Inward System Access (DID), Extension Dialing, Voice Messaging, and ACD (Automatic Call Distribution). The ISDN-PRI interface must support the following features - • Call-by-Call Service Selection • Channel Negotiation • Calling party number (ANI) • Called party number(DNIS) • Billing Number (BN) • Non-Facility Associated Signaling (NFAS) • D-Channel Backup • Administration Connections with Automatic Restoration Temporary Signaling Connections	Vital		

Requirement ID	Functionality	Description	Criticality	Response	Comments
CC4.2	Ability to support DNIS, ANI & CLI features	Call Switching System should also support standard features like DNIS, ANI and CLI.	Essential		
CC4.3	Server or switch based PBX system	The PBX system can be either switch based or server based system.	Essential		
CC5.0		Automatic Call Distributor(ACD) :			
CC5.1	ACD features	Automatic Call Distributor(ACD) distributes incoming calls to a specific group of terminals used by agents. ACD is a feature used to route calls in a call center environment to the appropriate agents, based on factors such as time available, skill sets and priority levels.	Essential		
CC5.2	ACD feature	Handling incoming calls is the task of the ACD system that consists of hardware for the terminals, switches, Telephone lines and software for the routing strategy. The routing strategy is arule based set of instructions that tells the ACD how calls are handled inside the system. Most of the time this will be a set that determines the best available agent for a certain incoming call. To help make this match, extra variables are taken into account, most often to find out the reason why the customer is calling. Sometimes the caller's caller ID or ANI is used, more often a simple IVR is used to just ask for the reason.	Essential		

Requirement ID	Functionality	Description	Criticality	Response	Comments
CC5.3	System capacity to generate Call Detail Records	Call Detail Recording. The system must be able to generate Call Detail Records (CDRs).CDRs must be generated for both incoming and outgoing calls on trunk facilities, The Bidder must describe : • The information provided in a CDR. • The methods for outputting CDR data. Buffering must be provided in the event that the external call accounting system, or storage device, is unable to accept the CDRs for any period of time. How many CDRs can be buffered • If the system has the capability to provide a printed listing of CDRs as they are output. • The Bidder must provide samples of Call Detail Records.	Essential		
CC5.4	Password protection of system	System Management Security. Access to the system for management purposes must be logging password-protected. The system should have the ability to restrict the capabilities of the users based on the login IDs. The system must support the setting of an attempts threshold (number of attempts within a specific time period) for access to system management ports. If this threshold is exceeded, the system must automatically disable the login. The Bidder must describe his proposed system's ability to meet this requirement.	Vital		
CC5.5	Call Delivery to CSR's by ACD	Call Handling. Calls must be delivered to CSRs in First In / First Out order (order of arrival queuing). Calls must be distributed to the "most-idle" CSR. The Bidder must describe the algorithm for selecting the "most idle" CSR.	Essential		

Requirement ID	Functionality	Description	Criticality	Response	Comments
CC5.6	Priority Queuing facility in ACD	Priority Queuing. It is desirable that calls to certain trunk groups or to certain dialed numbers be assigned a higher priority than other calls and that calls which overflow from another split be queued ahead of other calls. The Bidder must describe this process.	Essential		
CC5.7	Call Queuing facility in ACD	ACD systems place calls into a queue, where they are typically handled in the order received.	Essential		
CC5.8	Handling of calls by ACD	ACD systems may handle routing of inbound or outbound calls, or in some cases a combination of the two.	Essential		
CC5.9	ACD ability to support priority handling etc.	ACD system should support skill base routing, multiple group support, priority handling and Queue status indicator.	Essential		
CC5.10	Monitoring in ACD	It should provide supervisor assistance and monitoring	Essential		
CC5.11	Real time MIS of ACD status	Real time remote monitoring of ACD queue, agent status, and no call answered, abandoned etc.	Essential		
CC5.12	ACD system's ability to announce average wait time & music to customer during hold up	Queue Specific Delay Announcement / Music. For basic ACD applications, the customers must be provided aqueue specific (different for each queue) delay announcement if a CSR is not immediately available to answer a call. If a CSR is not available to handle a call, the call must queue for the next available CSR. The system must be able to announce the average wait time to the caller. The system must offer the caller the option of opting out to automated information (i.e. IVR) or call back facility The system must be able to provide music and announcements on hold until the call is answered. The Bidder must describe how the proposed system meets these basic announcement requirements.	Essential		

Requirement ID	Functionality	Description	Criticality	Response	Comments
CC5.13	Monitoring of CSR's availability/ non availability	Tracking CSR Activities by Reason Codes / Automatic Availability / Wrap Up Work. In order to give call center managers detailed information about how CSRs spend their time and to develop precise staffing forecasting models, CSRs must enter a numeric code that describes their reason for entering non-available work modes or for logging out of the system. At least 9 codes must be supported. CSR sets must have the ability to be automatically available to take the next call upon disconnecting from the current call. CSR sets must have the ability automatically to go into a wrap- up, unavailable work state at the completion of a call. CSRs must also be able to temporarily remove themselves from the call queue to perform call related tasks. Time spent in this work state (e.g., wrap up, lunch, restroom, etc.) must be included in the individual CSR and group statistics. In addition, the supervisor must be provided with a visual real time indication of CSRs spending time in this state.	Essential		
CC5.14	System ability to permit SR to activate alarm in case of emergency	Emergency Notification. The system must allow CSR positions to activate an alarm notifying a supervisor of an emergency condition. The system must also have the ability to automatically record the trunk number and/or calling number if provided, the CSR position involved in the emergency, and to activate a recording of the conversation with recording equipment provided.	Essential		

Requirement ID	Functionality	Description	Criticality	Response	Comments
CC5.15	System capability to permit CSR to take help from supervisor to deal with an active call	CSR Request for Assistance. The CSR set will have the ability to directly signal the supervisor when the CSR requires assistance handling an active call. Answering of CSR requests for supervisor assistance must be provided on the supervisor's set with special audible and visual notification; so that the supervisor may readily identify that a CSR requires support. The LCD or alphanumeric display must provide identification of the calling CSR to the supervisor without referring to the supervisor terminal.	Essential		
CC5.16	Supervisors as CSR's during busy periods	Supervisors As CSRs. Supervisors must have the capability to receive ACD calls during busy periods.	Essential		
CC5.17	Supervisor ability to logout CSR's from its terminal	Logout of CSRs by Supervisor. Supervisors must be able to logout CSRs from their own "soft phone" or supervisor terminal without having to go to the CSR's desk. They must also be able to log a CSR out from a remote location.	Essential		
CC5.18	System ability to enable monitoring a	Monitoring CSR Conversations The supervisor must be able to monitor a CSR's	Essential		

Requirement ID	Functionality	Description	Criticality	Response	Comments
		conversation for training or administrative purposes from the supervisor set, without plugging in to the CSR's "soft phone" set. The proposed system must also meet the following requirements : • Both silent monitoring and tone indication to the CSR during monitoring must be available. • The system must offer a "soft phone" or supervisor terminal capability for monitoring directly at the CSR's "soft phone" or supervisor terminal for "ride along" CSR training. • The "soft phone" or supervisor terminal must be equipped with two jacks in order to permit a supervisor to plug into the "soft phone" set for training purposes.			

Requirement ID	Functionality	Description	Criticality	Response	Comments
CC5.19	CSR set ability to view call center MIS regarding ACD statistics on real time basis	Access to Real Time ACD Statistics. Each CSR set must have the ability to view a customizable list of Call Center MIS information on the digital display of the CSR "soft phone". This information shall be individually configured or selected from a pre-defined list of MIS templates such as current split/skill performance, application performance, and individual performance status. CSRs and supervisors must be notified via the "soft phone" or supervisor terminal indicators when thresholds are reached for individuals and groups. The capability must also exist to notify via email. CSRs must be able to receive continual real-time display updates of ACD statistics via their display including such information as a comparison of individual performance to group averages or objectives. The display of ACD statistics on the "soft phone" or supervisor terminal must include, but is not limited to, the following items: • ACD calls • calls abandoned • calls waiting • oldest call waiting • average speed of answer • average time to abandon • percent in service level • CSRs staffed • CSRs available • CSRs on ACD calls • CSRs on extension calls • calls handled by CSR • calls completed by CSR	Essential		

Requirement ID	Functionality	Description	Criticality	Response	Comments
CC5.20	System ability to provide real time monitoring of CSR's to supervisor	Real Time Monitoring Reports. The system must support real time monitoring of CSRs, split/skill groups, trunk groups, and applications. Reports must be available in both text based and full color, graphical formats. The supervisor must be able to see at a minimum (in plain language and color graphical formats) information including but not limited to each of the following items: •the active CSRs and the current individual CSR status (whether on an active ACD call, in after-call work, waiting for an ACD call, or in an inactive or idle state). •the number of CSRs currently in various work states such as available, on ACD calls, in unavailable modes. •drill down capability to see individual performance data for a given CSR. •the current queue status including calls waiting, oldest call waiting, number of calls handled, number of calls abandoned, service level, etc. •a display of how CSR time is spent based upon assigned reason codes for unavailable non call associated work modes. For example: how much time CSRs spent on breaks, in group meetings ,training, etc. At least nine different reason codes are required for reporting time spent unavailable. These must be reported individually on each individual CSR report. •a call handling time profile which displays the number of calls answered and abandoned according to increasing service intervals. For example, how many calls were answered and abandoned from 0-5 seconds,	Essential		

Requirement ID	Functionality	Description	Criticality	Response	Comments
		5-30 seconds, 30-60 seconds, 60-90 seconds, etc. •the number of times during the current interval that a CSR reported a call event. This will assist Utility in keeping count of specific customer requests or types of calls. At least nine different call events must be tracked.			
CC5.21	System ability to support call overflow rerouting	Call overflow : The system should support call overflow routing e.g. if there is a queue in particular ACD group and another group is sitting idle, system should be able to transfer the calls to another group based on the settings defined by the administrator.	Essential		
CC5.22	System ability to rate CSR's on various parameters	Skill Assignment and Preference Levels. The proposed system must be able to assign individual skills to each CSR (i.e. bilingual, training or experience level, product knowledge, customer knowledge, etc.). Individually assigned skills must be able to be ranked and rated in terms of priority, proficiency or preference - • the maximum number of simultaneous skills queries and routing requests that can be executed at a time • how call processing is affected with a server or link failure • backup and recovery options	Essential		

Requirement ID	Functionality	Description	Criticality	Response	Comments
CC5.23	System ability to route calls depending on skills of CSR	Skills-based Routing - The proposed system must be able tomatch the requirements of thecaller to a CSR with the skills to handle the call. The Bidder must explain how this is accomplished. The system must assure that the CSR will receive a waiting call for his/her primary assignments even if a secondary skill assignment call has been waiting longer. Alternatively, on a CSR by CSR basis, the system must provide that a CSR always receives the highest priority, oldest call waiting for any of the CSR's skill competencies on a "greatest need"	Essential		
CC5.24	System ability to modify CSR skills dynamically	Changing CSR Skill Assignments-The ability must be provided to add or remove CSR skills dynamically while CSRs are on calls. The system must provide the capability for CSRs to be logged into one or more splits/skills when being moved between CSR groups.	Essential		
CC5.25	CSR ability to login on any soft phone	Virtual Seating or Free Seating - The proposed system must support the concept of virtual seating. CSRs can log-on from any "soft phone" instrument within the system. CSRs on the proposed system will be logically defined, rather than requiring a "soft phone" extension and termination. Each CSR and supervisor on the system must have an individually assigned log- on identification number which permits individual statistics to be collected by the ACD management information system. Multiple log-on events by the same individual during a work period at different terminals must be tracked individually as one "shift".	Essential		

Requirement ID	Functionality	Description	Criticality	Response	Comments
CC5.26	System to have integrated auto- attendant routing	Integrated Auto-Attendant - The system must provide integrated auto-attendant routing functionality such as "If you know the extension of the party you wish to speak with, you may dial it now". The system must have the capability to prompt customers for the type of service they desire, i.e. "Press 1..., Press 2..." The proposed system should support these capabilities internally within the proposed Switching/ACD system even without requiring an external IVR.	Essential		
CC5.27	System ability to provide announcement	Announcement Hardware / Capacities - The system must provide customers in queue with a variety of announcements. This capability must be inherent within the ACD architecture avoiding the need for external announcement devices and/or IVR servers.	Essential		
CC5.28	Flexible announcement features in system	General Announcement Features - The system must be able to force customers to listen to an entire announcement before being connected to a CSR. Alternatively, the system must be able to immediately connect a call to the CSR if a CSR becomes available before an announcement is completed. The supervisor must have the capability to control which method is being used.	Essential		
CC5.29	Call Identification Tag facility	Unique Call Identification Tag - A unique tag must be associated with each call when it originates and remain with the call throughout a multi-site network to facilitate cradle to grave call tracking.	Essential		
CC5.30	Call Routing capacity of ACD	Call Routing Commands/ Capacity. The system must promote an autopilot approach to call routing by providing routing tables of selectable commands and conditions and using Standard English commands.	Essential		

Requirement ID	Functionality	Description	Criticality	Response	Comments
CC5.31	Database maintenance for call routing	Integrated Routing Database Tables - A database must be maintained in the system for specialized routing purposes (e.g., a table of priority customers which would receive priority routing and possibly queue to a dedicated CSR).	Essential		
CC5.32	Call Routing Comparator facility in ACD	Call Routing Comparators - Comparison operators such as "less than", "greater than", etc., must be available for constructing vector routing commands.	Essential		
CC5.33	Wildcard Digit matching capability in Call Router	Wildcard Digit Matching for Call Routing - The system must be able to match ANI or other digits in routing tables using wild card sequences that would identify and route specific calls to a specified destination. Bidder must describe type of wild card digit.	Essential		
CC6.0		CSR AND SUPERVISOR TERMINALS			
CC6.1	General functionality of CSR & supervisor functionalities	General Functionality - The CSR and supervisor terminals must use open architecture state- of the art technology and be widely used, generally available and standard equipment. Bidder will provide the desktop PCs/ workstations and headsets to interface with the proposed solution. The Bidder must offer ACD "soft phone" and supervisor terminal functionality that is controlled by a PC-based CSR interface.	Vital		
CC6.2	CSR station technology	CSR Station - Bidders must propose "soft phone" technology for the CSR station. The proposed solution must integrate with PCs provided by Bidder. PC specifications are specified in hardware section. As an option, the Bidder must describe available touch screen operation for CSRs.	Vital		
CC6.3	CSR 'soft phone' support abilities	CSR Headset / Handset	Vital		

Requirement ID	Functionality	Description	Criticality	Response	Comments
		Operation - The CSR "soft phone" set must be able to support both a CSR headset and a CSR handset. There must be volume controls for each. The Bidder has to provide soft phone with amplifier and head set.			
CC6.4	Incoming call announcement capability of system	Incoming Call Announcement - The system must provide audible and visual whisper indication prior to the automatic connection of an ACD call to the CSR. For CSRs that handle calls for multiple applications, a whisper must indicate what type of call is arriving so that the CSR can greet the caller appropriately. The "soft phone" must also display this information to the CSR before delivery of the call.	Vital		
CC6.5	Call Hold, Transfer & Conference features of CSR & Supervisor soft phone	Hold, Transfer & Conference Features - A dedicated, fixed feature button, for each function, must be provided on the CSR and supervisor "soft phone" set. The system must have the capability for CSRs and supervisors to set up conference calls for a minimum of 4 parties (including the CSR supervisor) without requiring attendant assistance.	Vital		
CC6.6	Personalized Greeting recording capability of CSR softphone	CSR Personalized Greeting -The system must offer the capability for CSRs to record personalized greetings that can be played to the caller prior to connection to the CSR.	Essential		
CC6.7	CSR phone system ability to have & accept event codes	Entering Event Codes (Wrap Up) - CSRs must be able to enter codes to identify events that occurred during a call and to enter wrap up codes before becoming available for another call.	Essential		
CC6.8	CSR phone system ability to have & accept call identification	Entering Call Identification Codes - CSRs must be able to associate other types of identifying information, such as consumer code, to particular calls. The system must support up to sixteen digits per code.	Essential		
CC6.9	Audio fault reporting & tracing ability	Audio Difficulty Trace - When a CSR experiences static or a noisy trunk, the audio difficulty must be easily reported and traced.	Essential		

Requirement ID	Functionality	Description	Criticality	Response	Comments
CC6.10	System ability to route calls based on DNIS	Routing Based on DNIS - The system must be able to route calls based on Dialed Number Identification Service (DNIS).	Essential		
CC6.11	System ability to route calls based on ANI	Routing Based on ANI - The system must be able to route calls based on Automatic Number Identification (ANI).	Essential		
CC6.12	System support for network provided customer information digits	Support for Network Provided CINFO Digits (Caller Information Forwarding) - The system must have the ability to collect caller entered digits (CED) and customer database provided digits (CDPD) supplied by the network in an incoming call's ISDN PRI setup message and provide routing based upon these digits.	Essential		
CC6.13	System ability to divert calls to IVRS based on conditions	Overflow Destinations - Calls must have the capability to be automatically overflowed to a voice response system based upon conditions in the call center including call volume and time of day.	Essential		
CC6.14	Ability of ACD system to request & collect customer information & route call	Route by Caller Prompted Information - The ACD system must be able to request and collect information, such as a consumer no, and then route the call based upon that information. The system must have the ability to prompt a caller for up to 12 fields containing up to 16alpha/numeric characters of information.	Essential		
CC7.0		MANAGEMENT INFORMATION SYSTEM			

Requirement ID	Functionality	Description	Criticality	Response	Comments
CC7.1	System ability to provide real time & historical reports	Basic Internal Reporting - The system must provide basic low-cost, integrated reporting that does not require administration, external processors or external storage. Both real time reports and historical reports are required. Historical reports must be available for hourly or half hourly intervals. The proposed system must be capable of displaying reports on a video display terminal in real time or emailing them.	Vital		
CC7.2	System ability for creation of custom reports	Custom Reporting - Fast, easy creation of custom reports from scratch is required as is modification of existing reports to customize them for reporting purposes. Report customization must include the ability to create custom data items and define custom calculations.	Essential		
CC7.3	ODBC compliance of database	Open Data Base Connectivity -The database must be ODBC compliant.	Essential		
CC7.4	System ability to transfer call center data for other applications	Exporting Data - It is desirable that call center data be exported to file or directly to other applications (e.g., other database systems, web servers).	Essential		
CC7.5	System ability to provide access to MIS from remote	Remote Access -Supervisors must be able to access the management information system and monitor and administer the call center from a PC at remote locations.	Vital		
CC7.6	'Cradle to Grave' reporting by system	Cradle to Grave Reporting-The system must support "cradle to grave" reporting which would reveal exactly what happened to a caller from the time they entered the system until the time they hung up, and everything in between.	Essential		
CC7.7	System ability to support call record queries via web browser	Web Browser Interface - The system must support customized queries of detailed call records via an industry-standard Web browser and/or graphical user interface.	Essential		

Requirement ID	Functionality	Description	Criticality	Response	Comments
CC7.8	Long term record storage	Long Term Storage of Detailed Call Records - The system must provide for long-term storage of detailed call history records.	Essential		
CC7.9	Comprehensive Historical Reporting	Comprehensive Historical Reporting - Historical reports must be available for CSRs, split/skills, trunk groups, and applications in interval, daily, weekly, and monthly formats. Both graphical and text based formats are required. It is required that reports be printed on demand and on a scheduled basis. Historical data must be stored. Real Time reports must update automatically approximately every 3 seconds or less.	Essential		
CC7.10	Graphical PC based reporting	Basic Graphical PC based Reporting-The system must provide real-time graphical reporting (bar-chart, pie-chart, time trace, wallboard, or text report display formats) to multiple supervisors, such as : • support of multiple external PC-based wallboards for display of real-time data to various ACD groups • text messages created by supervisors displayed on PC- based wallboards • set thresholds on data items that alert supervisors both visually and audibly when thresholds are reached and be able to send beeper/text messaging device • Supervisor ability to customize views for real time monitoring of items and	Essential		
CC7.11	LAN connectivity of CSR PC's for remote MIS access	Local Area Network Connectivity - Supervisors must have access to the management information system via a PC connected to a local area network using TCP/IP protocol.	Essential		

Requirement ID	Functionality	Description	Criticality	Response	Comments
CC7.12	Exceptions & threshold reporting by system	Exceptions and Thresholds- The following reports capabilities are required : • Real time reports displaying color threshold indications for items that are exceeding desired levels such as number of calls in queue or oldest call waiting time. • Definable exception categories and thresholds. Bidder must fully explain if thresholds can vary between different splits and applications or are they set for the entire system. • Supervisors receive notification of all defined exceptions. • Recent exceptions be displayed on demand.	Essential		
CC7.13	Backup process performance	Backup Process - Backups must be performed scheduled or on demand.	Essential		
CC7.14	Online Help	Online Help - The system must provide Browser/GUI-based online Help.	Essential		
CC7.15	Alarm in event of problem or error	Alarms and Error Conditions - The system must generate an alarm and notify service personnel in the event of system problems or errors.	Essential		
CC7.16	Integrated Forecasting Capabilities of MIS	INTEGRATED FORECASTING CAPABILITIES - The Management Information System must offer integrated Forecasting capabilities based on AHT (average Handle time) and no of CSR etc. It is desirable the proposed solution has a call center simulator or the ability to provide "what if" forecasting scenarios considering the factor such as holidays, special campaigns, season trends, billing cycles, and other date of month influences are taken into consideration. Assignment of work shifts to employees. Generate an optimal schedule for CSRs for each hour that meets the forecasted call volume taking into consideration CSR availability, calendar management, and our desired service	Essential		

Requirement ID	Functionality	Description	Criticality	Response	Comments
CC8.0		Interactive voice response system (IVRS) :			
CC8.1	IVRS with ASP features with text to speech & text to fax capabilities	Interactive voice response system, or IVRS, is a computerized system that should allow a telephone caller, to select an option from a voice menu. The system should play a pre-recorded voice prompts to which the person presses a number on a telephone keypad to select the option chosen, or speaks simple answers such as "yes", "no", or numbers in answer to the voice prompts. Advanced Speech Processing (ASP). The multiple advanced speech processing technologies (large vocabulary recognition, natural language understanding, speaker verification, speech-to- text) may be required as features. The ASP technology should be provided with software that runs on an open, industry standard subsystem platform under supplied OS. The	Vital		

Requirement ID	Functionality	Description	Criticality	Response	Comments
		platform must permit qualified third party developers to integrate additional ASP technology and functions. ASP shall support English and local language. The latest system of natural language speech recognition shall be used to interpret the questions that the person wants answered. Latest innovations of its ability to speak complex and dynamic information such as an e-mail or any other information using Text-To-Speech (TTS), which is computer generated synthesized speech, shall be used. Real voices are used to create the speech in tiny fragments that are glued together before being played to the caller. Text to FAX capabilities. The IVR Bidder must support this functionality consistent with the languages supported by the Text to Speech, ASP. IVR will provide multiple options to callers for self- retrieval of information by fax.			
CC8.2	IVRS system features	IVR systems shall generally be used at the front end of call centers to identify what service the caller wants and to extract numeric information such as electricity payment dues, bill payment status as well as provide answers to simple questions suchas completion of fuse off calls or allow pre-recorded information to be heard. The IVR Systems should be properly designed so as to connect callers to their desired service promptly and with a minimum of fuss.	Essential		

Requirement ID	Functionality	Description	Criticality	Response	Comments
CC8.3	Scalability of IVRS	The IVR System should be scalable as per the locations of consumer base. All the calls received at the call center shall first land on the IVRS, the system shall welcome the user and present a voice menu to select the service he requires and also key in and retrieve information from the system. The IVRS shall be CTI supported so that all the information entered by the caller on the IVRS is to be passed to the customer service representative screen as popup.	Vital		
CC8.4	IVRS capability to handle variable call volume	The average call duration is 2 minutes; The IVR system must be able to accommodate fluctuations in call volume.	Essential		
CC8.5	Response Time of IVRS	Response Time / Performance / Availability - The response time must be no more than 2.0 seconds. The worst-case IVR response time (not the average)must be measured with all phone ports simultaneously speaking different messages (different or the same). The response time must be measured using the following two scenarios: • The time the user completes input until the start of voice output is heard; and • From the time a host message is received until the start of voice output is heard. • The requirement is for the IVR system to be available in a 24 X 7 X 365 for general narrative information and customer billing information.	Vital		

Requirement ID	Functionality	Description	Criticality	Response	Comments
CC8.6	General Architectural Requirements of IVRS	General Architectural Requirements - Although the Bidder will propose the general architecture of the system, there are certain overall aspects of the system that the Utility considers important to include. These are : • For effective use of memory capacity, the system must permit multiple applications to use common speech files to handle items unique to an application along with common items. • The IVR system must be built employing open industry standards and widely-used and generally available components and software. • The system must be a client– server architecture that is scalable. • The proposed IVR system mustinterface with the Customer care systems and database.	Vital		

Requirement ID	Functionality	Description	Criticality	Response	Comments
CC8.7	Redundancy of connections for tele-communication & LAN network	Redundancy / Alternate Call Routing - The IVR system must have redundant connections to both the telecommunications network and the Local Area Network (LAN) interfaces. These connections must have failover capability to support both voice and data traffic. These failover connections are to ensure redundancy in the event of failure within the network servicing the IVR, and for the LAN providing the data from the back-end systems. Each of the links must be capable of supporting the emulation of multiple terminals. Recovery from power interruptions and system problems must occur automatically. The system must include provisions to monitor all centers 24 hours per day, 7 days per week and the capability to conduct online, on-demand and routine diagnostics to determine general status of the IVR and its applications without interfering with service. The telephone connections required for this purpose has to be arranged by the bidder and cost of the same shall be reimbursed by the utility in actual.	Vital		
CC8.8	Processor & system standards for IVRS system	To ensure that the proposed IVR platform can support growing and changing needs, the bidder shall provide a platform based on an industry standard processor and operating system. • The kernel of the operating system must not be modified or use proprietary drivers. • The system must be a modular design to support expansion and enhancement to major components of the IVR system.	Vital		

Requirement ID	Functionality	Description	Criticality	Response	Comments
CC8.9	Menu tree complexity of IVRS system	IVR Menu Tree Complexity -Based on the business process requirement the bidder has to design menu tree structure. The menu structure should not be more than 4 levels with 4 to 5 options per level. Each of the IVR system's menu options will need to be reviewed with the utility prior to IVR development to ensure that all business functions are implemented as needed. The Bidder must make recommendations on the best way to implement the required functionality of the menu trees.	Essential		
CC8.10	Integration of IVRS with Call centre networks	IVR Data Base Interfaces - The required method of connectivity is to integrate the proposed IVR to networks located at CC centre with the master database of the utility This connectivity should be through a single point, with redundancy provided through 2 connections at the single point.	Vital		
CC8.11	General Functionality of	General Functionality -The IVR must be designed with the following parameters to manage / limit the following call transaction and duration characteristics : • total transaction (call length) • individual message input (response to a prompt) The parameters must be configurable by the Bidder and Utility with no interruption of production applications running on the system.	Essential		

Requirement ID	Functionality	Description	Criticality	Response	Comments
CC8.12	IVRS functionality	INTELLIGENT CALL ROUTING REQUIREMENTS -If it becomes necessary to shutdown an IVR application, the system must be capable of providing an announcement to the caller. Utility must be able to take all lines out of service after the completion of the call in progress on each line. This must be initiated by console command or host command. The IVR system must be able to automatically restart following a power failure. When the host systems are unavailable, the IVR must be capable of responding to incoming calls in various different ways. First, it must offer the capability to answer incoming calls and announce either "Information not available at this time" or "System unavailable" (as examples). Secondly, the system must have the ability to make all ports appear busy. It is desirable to have the system's response to this condition be controlled by the application software, rather than defined at the system level. The following additional functionality is required when a host or IVR application is unavailable to the caller: • Ability to directly route all incoming calls to the CSRs for complaints handling • Ability to route incoming calls to a CSR when the Customer has difficulty in accurately inputting their customer no. • Ability to route incoming calls to CSR when the data server or an IVR application is down during business hours and the Customer can not access specific information during an Information Inquiry.	Vital		

Requirement ID	Functionality	Description	Criticality	Response	Comments
CC8.13	Graphical tool for monitoring & Reporting on real time / on demand basis	Monitoring, Statistics and Reporting - Each system must provide a graphical tool for supervisors, managers and system administrators for real- time monitoring of the system. Utility requires ad hoc reporting, upon demand. The system must include an administration or management tool for local and remote monitoring and management of every component of the IVR system. The monitoring tool must allow for immediate or progressive shutdowns and for shut down of single or multiple telephone lines, host connections, processors, applications of the entire system. The management tool must be secure from unauthorized users and available to one or more administrators concurrently. The management tool must be accessible via remote access. At minimum, reporting features must capture all of the following criteria and be available on-line, in real time: • Ability to generate traffic and performance reports online on a daily, weekly, monthly and quarterly basis. • Application statistics must be provided on an event basis and accumulated by specific applications in the IVR and by Customer ID. •Application statistics must be provided showing the number of times a Customer is transferred to a CSR during a Information Inquiry transaction. •Report information to include downtime, system usage by event script application, calls aborted, average length of call, busy hours, average call hold time by script application accessed. •Cumulative data to the previous hour must be available at the half-hour. •System capability to permit automatic scheduling of certain routine tasks at specific intervals. This would include report generation, data collection, and transfer or scripts for administration. A log file provided to review activities. •The reporting system must track historical and real-time information. The reporting system must be capable of creating, saving and printing both standard and customized reports. The real time monitoring and reporting must be accomplished in a windowing environment. Monitoring and	Essential		

Requirement ID	Functionality	Description	Criticality	Response	Comments
		reporting must include security features to ensure access only by authorized personnel. •Common monitoring statistics across all systems include call volumes, IVR uptime, utilization, billing, max/min call usage, average length of call, average queue depth, average hold time and logging (for legal traceability).			
CC8.14	IVRS announcement changes	The bidder shall keep provision for making changes in the IVRS announcement as per the request of utility within two days.	Essential		
CC8.15	IVRS ability to respond to each call	IVR will be responsible to answer each and every call and multilingual / multilevel option to be provided to the caller based on the dialed number (DNIS).	Essential		
CC8.16	IVRS ability to provide user defined rule based information	IVR should provide user defined rule based routing e.g. IVR can automatically play payment balance, energy used etc. in the current month based on the data captured (CLI) or entered by the subscriber.	Essential		
CC8.17	IVRS ability to route call to requisite ACD group	IVR will route the call to the appropriate ACD group e.g. billing enquiry, fuse off complaints, new payment schemes, technical support etc.	Essential		
CC8.18	IVRS ability to present customer dialing details to ACD	IVR should also capture customer's dialing details and presenting them to ACD or CTI directly to make routing of calls easier by identifying the calls i.e.by identifying the customers from DNIS, CLI, ANI or internal calls etc.	Essential		
CC8.19	Integration of other voice related technologies	Other voice related technologies shall also be integrated to IVR system.	Desirable		

Requirement ID	Functionality	Description	Criticality	Response	Comments
CC8.20	IVRS (all applications) performance testing by bidder	a) Performance Testing. Because the Bidder will be delivering hardware and software across all applications, the Bidder must provide performance testing for each application before full acceptance of a system by Purchaser. b) Testing, Diagnostics, and Monitoring. The Bidder must develop, implement and install the new IVR systems. The hardware, software and developed application must be tested prior to full production implementation. The Bidder's must complete the installation and provide pre-installation site preparation to ensure proper environments and adequate space is available for the IVR. The Bidder must ensure that the system is fully integrated with existing database server and equipment. The Bidder is required to perform extensive testing, based upon the requirements for each application, including but not limited to Bidder testing, and acceptance testing. These tests will include load testing, and verification that the application works at each location. Testing must include hardware, software and application full integration and systems testing, stress testing, post implementation testing and parallel testing, where appropriate. The Bidder is responsible to establish the testing environment. The Bidder must coordinate with Purchaser for transition from the existing systems if any to the new systems without interference with production systems. Adequate reporting must be available to allow both the Bidder and Purchaser to measure the system's performance accurately under defined test conditions and in defined environments. The Bidder must develop and submit a Test Plan including resource requirements and , schedules, for complete testing of each of the applications, with test criteria to support all hardware and software	Vital		

Requirement ID	Functionality	Description	Criticality	Response	Comments
		performance requirements, IVR system features, interfaces, and architectural, communications and security requirements. The Bidder must include a disaster recovery procedure to insure that the systems are always available. The Test Plan must include the intended plan and justification for the chosen testing environment(s) throughout the entire testing lifecycle. Contingency plans must be defined in the event the Test Plan cannot be carried out, as initially planned. Purchaser must approve each segment of the Test Plan before testing begins			
CC8.21	Documentation & Training to Customer	TRAINING AND DOCUMENTATION - a) Common Initial Training Requirements. The Bidder must provide SOCC site training for	Vital		

Requirement ID	Functionality	Description	Criticality	Response	Comments
		Purchaser staff at the time of installation. Initial training must include training on the overall functionality and monitoring capabilities of the Call Center, statistical monitoring and generation of ad hoc reporting capabilities. The Bidder must provide train- the-trainer training and documentation to the CSRs and supervisors. They must also provide training for any administrator or programmer. Purchaser requires the Bidder to develop a training document (pamphlet, binder, or manual) for each IVR application, outlining the Customer interfaces of each application for distribution among Customers who will use the applications. The Bidder must provide PURCHASER with copies of all documentation regarding the IVR applications and Call Center application, including a User Manual. The Bidder must provide basic maintenance training and support training to Purchaser's staff. b) Unique Training and Documentation Requirements. The Bidder will provide Purchaser's staff with training, documentation and tools to allow the PURCHASER staff to make ACD and IVR system script or vocabulary changes			

Requirement ID	Functionality	Description	Criticality	Response	Comments
CC9.0		Voice Messaging :			
CC9.1	Voice Mail facility	It is used for recording, storing, playing and distributing phone messages to agents and / or group. The voice messages could be attached as e-mail messages and routed to agents. Voice Mail provides the customers the choice to leave their requests e.g. call back requests in times of long time queuing etc.	Vital		
CC9.2	Retrieving of voicemail	Voice mail requests can be retrieved and played back at any time from agent's voicemailboxes or via their desktops.	Essential		
CC9.3	System ability to keep log of all messages	The system should keep a log of all voice messages, senders, receivers date & time etc. for reporting purpose.	Essential		
CC9.4	No. of IVR ports	The no. of IVR ports should be equivalent to the incoming voice channels to provide non-blocking facility.	Essential		
CC10.0		Computer telephony integration (CTI)			

Requirement ID	Functionality	Description	Criticality	Response	Comments
CC10.1	CTI system	CTI (Computer telephony integration) is the technology that allows interactions on a telephone and a computer to be integrated or co-ordinated. The following functions are implemented using CTI –) Calling Line Information Display (Caller's Number, Number Called, IVR Options)) Screen Population on answer, with or without using calling line data) On Screen Dialling (Fast dial, preview and predictive dial)) □ On Screen Phone Control (Ringing, Answer, Hang-up, Hold, Conference etc.)	Vital		
CC10.2	CTI forms	Forms of CTI – Generally there are two forms of CTI – a) First-party Call control – Here, only the computer associated with the phone can control all the functions of the phone at the computer user's directions. b) Third-party Call control – It requires a dedicated telephony Server to interface between the Telephone network and Computer network. Any computer in the Network has the potential to control any Telephone in the telephone system. The phone does not need to be built into the computer and may only need to have a microphone and Headset in the circuit. For the proposed Call centre, the agency should provide CTI with Third party call control.	Vital		

Requirement ID	Functionality	Description	Criticality	Response	Comments
CC10.3	CTI ability to transfer Information from PBX & IVR to CSR's CRM screen	The CTI (Computer Telephony Integration) component shall be required for passing all the information from the PBX and IVR, such as the caller identification, Dialled number information, Language option service opted by the caller etc., to the CSR's CRM screens.	Essential		
CC10.4	Integration of agent application to CRM	The system should provide an agent application integrated with CRM application. It should pop- up along with the caller information, when the call	Vital		
CC10.2	CTI forms	Forms of CTI – Generally there are two forms of CTI – a) First-party Call control – Here, only the computer associated with the phone can control all the functions of the phone at the computer user's directions. b) Third-party Call control – It requires a dedicated telephony Server to interface between the Telephone network and Computer network. Any computer in the Network has the potential to control any Telephone in the telephone system. The phone does not need to be built into the computer and may only need to have a microphone and Headset in the circuit. For the proposed Call centre, the agency should provide CTI with Third party call control.	Vital		
CC10.3	CTI ability to transfer information from PBX & IVR to CSR's CRM screen	The CTI (Computer Telephony Integration) component shall be required for passing all the information from the PBX and IVR, such as the caller identification, Dialled number information, Language option service opted by the caller etc., to the CSR's CRM screens.	Essential		

Requirement ID	Functionality	Description	Criticality	Response	Comments
CC10.4	Integration of agent application to CRM application	The system should provide an agent application integrated with CRM application. It should pop- up along with the caller information, when the call comes to the agent. The CLI should have the capability to popup all the vital customer data on screen.	Vital		
CC10.5	CTI system ability to enable control of telephony features from GUI application	The Agent should be able to control the telephony features from this GUI application like login, logout, away, pick-up, hold, hang-up, conference, and transfer to another agent along with the screen (voice and data). Screen pop-ups should be multi- coloured. CRM components, queries or call priorities should be recognizable by the colour of the pop-up.	Essential		
CC10.6	CTI system support for login from any workstation	The system should support virtual login e.g. an agent can sit anywhere and login by putting his login id and that becomes his workstation.	Essential		
CC10.7	Report generation capability of CTI system	Entire login, logout, away, total call handled, data of the agent should be captured and produced as reports.	Essential		
CC10.8	Online display of ACD queue	The Agent application should also have the online monitoring display of the ACD queue(s).	Essential		
CC10.9	Integration of CTI application to billing & consumer indexing database	The CTI application should also record a ticket on each call for reporting purpose. The docket shall be opened by the CC centre and should be closed only after the customer is satisfied. The system shall have the capability to integrate with the utility's billing and consumer indexing database.	Vital		
CC11.0		DIALER :			

Requirement ID	Functionality	Description	Criticality	Response	Comments
CC11.1	Automatic Dialling System	The dialler system should be capable of interfacing with the CRM for automatically dialling out to the consumers to deliver information like power supply position, payment reminders, payment acknowledgement and other information. The dialler should also be capable of working in both predictive and progressive modes depending on the requirement.	Essential		
CC12.0		Remote monitoring capabilities			
CC12.1	Remote monitoring ability of ACD status, no. of agents etc.	The system should support remote monitoring of real time ACD statistics, queue, and number of agents, abandoned, answered calls from their office using the application provided by the system. The application software shall have the facility for fault escalation to various administrative levels of utility depending upon the delay in clearance.	Essential		
CC13.0		Database Integration: -			
CC13.1	System integration with billing module & Consumer indexing & asset mapping module	The System should support retrieval of data from Utility's computerized billing, Consumer indexing and asset mapping systems residing at different server e.g. if a caller wants to check his billing status, the IVR should retrieve the data in real time from the database residing at these servers.	Essential		
CC13.2	System integration with billing & consumer indexing modules	Certain database access, like Billing and consumer indexing, should be integrated with CTI for screen pop-up, CRM and priority handling etc.	Essential		
CC14.0	CRM features	CRM: - Some of the main features of the CRM are :	Essential		
CC14.1	Multiple host connectivity	Application should support multiple host connectivity- local as well as remote.	Essential		
CC14.2	Single Interface for customer interactions	Single interface for consistent customer interactions through multiple touch points.	Essential		

Requirement ID	Functionality	Description	Criticality	Response	Comments
CC14.3	Customer Feedback	Consolidated view of the customer to ensure that each agent has complete knowledge of every interaction regardless of the channel of communication.	Desirable		
CC14.4	Agent ability	The Agent should be able to rapidly create, assign, track, and resolve a complete range of service requests, cases, and trouble calls. They should also be able to generate confidence by successfully resolving inquiries. Brief description of all queries should be recorded.	Essential		
CC14.5	Standard features	Should support standard features for e.g. subscribers call history, booking of complaints etc.	Essential		
CC14.6	System ability to permit agents to extract information from system	The system should allow agents to capture and display contact information, problem descriptions, problem categorization, severity classification, prioritisation, and complete status tracking with open and closed dates and times.	Essential		
CC14.7	System ability to provide CSR with defect management data	Should provide Customer service professionals with comprehensive defect tracking capabilities, enabling to categorize, prioritise, and assign product defects for resolution based on input from incoming customer service requests to proactively correct product quality issues.	Essential		
CC14.8	Billing details for six months	Should provide option to view billing details of the customer(last six months records) on CTI pop up along with vital information of customer.	Essential		
CC14.9	Option to send billing details by e-mail/ fax	Should provide option to send the billing record (last six months) of the customer through e-mail / fax.	Essential		
CC14.10	Ability to view customer details	Should be able to view details of the customer with an authentic ID e.g. Consumer number, Name, Telephone number, Address and with an option to change the required parameters.	Essential		
CC14.11	Ability to build FAQ database	Should build a FAQ database for commonly asked query. In case of any changes in tariff, the FAQ should be updated within 1 day.	Essential		

Requirement ID	Functionality	Description	Criticality	Response	Comments
CC14.12	Search option for most similar answer to FAQ	Search option to find the most similar answer to the queries in the FAQ section with an option to e-mail the same to the customer also.	Desirable		
CC14.13	Report Generation module	Report generation module e.g. billing reports, customer details report etc. - CRM application will record the language preference of a customer and his next call will be routed according to his preference.	Essential		
CC15.0		COMPLAINTS ESCALATION SYSTEM			
CC15.1	Escalation policy	In case the issues are not resolved within the defined service levels, it shall be possible to escalate to pre-specified higher authorities. The escalation hierarchy would consist of three or more levels for escalation of complaints to expedite the complaint resolution process. The choice of escalation authorities would be made based on the criticality of the situation, which could include the AE/EE or even the SE of the Circle.	Vital		
CC15.2	Escalation policy	The call centre software shall have a facility for Automatic diversion of message from the Call Centre Supervisor's desk to the utility hierarchy as given above, if the complaints are not closed within 2 Hours. However, it shall be possible to escalate all the critical complaints like death / accident immediately to the respective Circle CEO as well as Town in-charge of the utility.	Vital		
CC16.0		OTHER SERVICES			
CC16.1	Complaint status enquiry	Status Enquiry - Consumers should be able to know the status of their complaint anytime by calling the CC center and providing the unique registration number / token number to CSR.	Vital		

Requirement ID	Functionality	Description	Criticality	Response	Comments
CC16.2	Payment reminders	Payment Reminders – It shall be possible for the CSRs in the CC center to follow-up with the consumers regarding payments. The appropriate details of such overdue consumers would be provided by the Utility to the call center Supervisor. Billing software shall generate weekly reports of such consumers, who have outstanding payments and should be forwarded to call center every week through automatic messaging services for further follow up with consumers. Concerned utility may also decide a cut-off point for consumers with such overdue payments, for whom call center will refuse to lodge any complaint till all the previous dues are cleared.	Essential		

Requirement ID	Functionality	Description	Criticality	Response	Comments
CC16.3	New connection and other facilities	New Connection and other activities – As this Call Centre will be a Single window option type, consumer will be approaching for providing new connection. Call center will provide the Application form to consumers for New Connection and will also collect, scrutinize and forward the same to utility official concerned. The back end operation will be done by the utility staff, but will keep the status updated in the system. Similarly, there are other activities for which the required application along with the required document if any will be collected by the call center and forwarded to utility official for sanctioning, changing the tariff category etc, such as – - Extension / Reduction of Load - Change/Transfer of Name - Address correction - Change of Category - Disconnection and re- connection of power - Any adhoc scheme etc. All the status should be available with the Call center at any point of time from the point consumer submits his application till the job is completed and the consumer shall get complete status of his application at any point of time from call center itself through Phone or in person.	Essential		

Requirement ID	Functionality	Description	Criticality	Response	Comments
CC16.4	Lead generation and marketing of services	**Lead generation and marketing of services-**The above shall be possible through the CSR personnel e.g. new payment modalities like direct debit facilities, ATP Machines, Bill payment through Credit Card, Cheque Drop boxes etc. could be explained to the consumers. The CSR should inform the consumers regarding tariff or any new service provided by the utility.	Desirable		
CC16.5	Group messaging system	**Group Messaging System -**The CC software should have facility to sent group messages to those consumers having Mobile phones as per the call centre database, such as- • Common message transmittal/warning in case of group faults (DT/Feeder failure etc)or any other information common for all consumers on power situation • Advance intimation to consumers regarding load shedding or planned shutdown or preventive **maintenance schedule** • **Date of bills generated and due date of payments**	Essential		
CC16.6	Closing of complaints	Closing of issues/requests - Once the issue is resolved or the fault has been attended, the concerned Electrical maintenance staff in the field will inform the status to the CSR through his CUG Mobile phone. The CSR personnel will update the status of the complaint as closed and will also intimate the customer of the same and take a feedback regarding service provided by his personnel.	Essential		

a) The Customer care centres would also be connected to the Data centres through a minimum 2 Mbps VPN connectivity from service provider along with ISDN line as back up connectivity. The Routers at Customer care centres shall also have ISDN BRI Card for ISDN connectivity in case of link failure.

i. CRM/CTI/IVRS server – One for each Customer care centre
ii. Portal, DNS, Mail, LDAP, Anti Virus, Reverse Proxy server at Data Center & Disaster recovery Center.
iii. Enterprise Management system (EMS),Network operation control Station at Data Center & Disaster recovery Center
iv. The Call Center should consist of CTI server, IVRS server and CRM server (Single server with multiple partition or discrete Server) as described in Server Section above along with ACD, Dialer and Voice Logger solution to integrate various customer services on a single point as described in detail in Section-G2 and can be either EPABX based or Server based.
v. The access by telephone shall be provided by interfacing the Call Center to PSTN through the standard signaling schemes or through IP Telephony . The system shall be configurable to handle the customer queries either through IVRS or manually. The call center equipment shall be designed for continuous operation.

b) HARDWARE REQUIREMENTS:

i) The Call Center shall support PSTN interface of minimum one E1 link either in R2MFC signaling or ISDN PRI or 32 DELs (Direct Exchange lines), as per the requirement for both incoming and outgoing calls The ultimate number of links with PSTN shall be designed and provided based on the traffic projections, which will be the average number of transactions per day to be handled across the counter as well as by phone, fax, e-mail, internet etc.

i) The hardware requirements of the Call Center shall vary depending upon the number of transactions to be performed through various accesses and the desired performance level defined.

ii) The Call Center shall support the number of agent positions of minimum of 4 to anultimate capacity of agent positions to be designed and provided based on the traffic projections.

iii) It shall support Voice Interface between the Call Center and local/remote agents for both incoming and outgoing calls.

iv) The system shall support Voice Mail Customers up to 1000.

v) The call centre shall provide a graphical console application program for the Supervisor's workstation PC.

vi) The CSR or agent terminal must be equipped with a work station PC, Hand set, Head set, soft telephone and IP Telephones for basic telephone handling functions. Agents shall be able to perform any of the above functions through the keypad of their telephone sets/headsets or through soft-phone application inter-changeably.

c) Electromagnetic Compatibility Requirement and standards :

The equipment to be installed in the call center shall conform to the EMC requirements asper the following standards :

a) Conducted and radiated emissions: - To comply with Class A of CISPR 22 {2000} "Limit and methods of measurement of radio disturbance characteristics of Information Technology Equipment"

b) Electrostatic discharge :- To comply with IEC 61000-4-2 "Testing and measurement techniques of Electrostatic discharge immunity test" under following test levels : Contact discharge level 2 {± 4 kV}; Air Discharge level 3 {± 8 kV};

c) Fast transients common mode burst:- To comply with IEC 61000-4-4 "Testing and measurement techniques of electrical fast transients/ burst immunity test" under level 2 {1 kV for DC power lines; 1 kVfor signal control lines}.

d) Immunity:- IEC 61000-4-3 "Radiated RF electromagnetic field immunity test" under Test level 2 {Test field strength of 3 V/m}.

e) Surges Common and differential mode:- To comply with IEC 61000-4-5 "Test & Measurement techniques for Surge immunity tests" under test levels of 0.5 kV for differential mode and 1 kV for common mode.

f) Radio frequency common mode :- To comply with IEC 61000-4-6 "Immunity to conduct disturbances, induced by radio frequency fields" under the test level 2 {3 V r.m.s.}; current Clamp injection method or EM clamp injection method for DC lines and Signal Control lines

D. Configuration & system availability

1. General

This chapter describes the requirement of monitoring and managing the SCADA/DMS-OMS system with regard to its configuration and availability under normal conditions and under hardware and software failure conditions.

2. System Redundancy

The SCADA/DMS-OMS system envisages some functions as critical functions and others as non-critical functions as defined in Chapters 1 and 2.The critical functions shall have sufficient hardware and software redundancy to take care of hardware or software failure condition whereas non-critical functions may not be provided with hardware and software redundancy.

The redundancy requirement for hardware of SCADA/DMS-OMS system shall be as follows:

i. Servers: The servers for SCADA/DMS-OMS, ICCP, Communication servers, ISR application, servers for DMZ/ security system systems, DR and shall be configured as redundant system. (Except for DTS , development server)
ii. LAN and device interface: LAN shall be configured as redundant . All equipment, except DTS, development system shall have single LAN)
iii. Printers: All Printers shall be non- redundant devices.
iv. Operator workstations: These shall be configured as non-redundant devices.
v. Time and frequency system: The GPS receiver of time and frequency system shall be configured as a redundant device at SCADA/DMS-OMS control centre.
vi. Communication front end (CFE): Communication front end shall be configured as redundant system.
vii. WAN Router: The WAN router connected to dual LAN shall have channel redundancy.
viii. DAT Magnetic tape autoloader shall be non redundant drive
ix. Video Projection System (VPS) shall be non redundant

Every critical function must be supported by sufficient hardware redundancy to ensure that no single hardware failure will interrupt the availability of the functions for a period exceeding the automatic transfer time. Non-critical functions are those that support maintenance and development of database, application software and training of users. No hardware redundancy is envisaged for these functions.

3. Server and Peripheral Device States

Server and peripheral device states represent the operating condition, of each server and peripheral device. The various states have been defined below: The system's reaction to restart/failover operations shall be governed by the state. Server and peripheral device states shall be assigned by the function restart, server and device failover functions, and by user command.

Server States : Each server shall be assigned to one of the following states:

i. Primary State: In primary state, a server performs any or all of the on-line functions described in this specification and is referred as primary server. A primary server shall concurrently perform maintenance functions (e.g. update of database, display and reports).
ii. dBackup State: A server in backup state is referred as backup server. A backup server replaces a primary server/primary server group in the event of primary server/primary server group failure or upon user command. It shall communicate with the primary server(s) to maintain backup databases and monitor the state of the primary server(s). A backup server shall concurrently perform maintenance functions.

iii. Down State: A server in down state shall not communicate with the computer system and is not capable of participating in any system activity.

4. Peripheral Device States

Each peripheral device shall be assigned to one of the following states:

i. Primary state: A device in primary state is referred as primary device. The primary device is logically attached to a primary server or primary server group. If the primary server or primary server group fails and its functions are reassigned to a backup server or backup server group, the device shall follow the reassigned functions.
ii. eBackup state: A device in backup state is referred as backup device. A backup device is used to replace a primary device in the event of primary device failure. It shall communicate with the primary server or primary server group to inform its readiness for it's assignment as a primary device. A device may be assigned to the backup state by the server function and by user action.
iii. A backup device may participate in on-line activity alongwith the primary device as can be the case with LAN s. For such cases, failure of any one device shall cause other device to take up the role of both devices.
iv. Down state: A device in down state is referred as down device. A down device cannot be accessed by the computer system.

Functional Redundancy : Every critical function must be supported by sufficient hardware redundancy to ensure that no single hardware failure will interrupt the availability of the functions for a period exceeding the automatic transfer time.

Non-critical functions are those that support maintenance and development of database, application software and training of users. No hardware redundancy is envisaged for these functions.

5. Backup Databases

Copies of all databases shall be maintained on the Backup server so that system operations may continue in the event of Primary server, peripheral device or software failure. The backup databases shall be updated with the current contents of the primary databases such that all changes to a primary database are reflected in the backup database within 60 seconds of the change. The backup databases shall be maintained in such a manner as to be protected from corruption due to server and device failure. Backup databases shall be preserved for system input power disruptions of any duration. The information maintained in the backup databases shall include:

i. fTelemetered, calculated, and manually-entered values and their attributes, including quality codes, control inhibit state, and tag data
ii. gData and associated attributes maintained by the Information Storage and Retrieval function
iii. Alarm, event, and summary displays (such as off-normal, control inhibit, and alarm inhibit displays) or sufficient information to rebuild the displays in their entirety (including the time and date of the original data entries, not the time and date the display is newly created)
iv. (dh) Application function execution, control, and adaptive parameters and input and output data, including DMS functions savecases.
v. Changes resulting from the addition or deletion of items and restructuring of databases in an existing database shall be automatically accommodated in the backup database.

6. Error Detection and Failure Determination

All servers, peripheral devices, on-line software functions, and maintenance functions in SCADA/DMS system shall be monitored for fatal error and recoverable errors. All errors shall be recorded for review by maintenance personnel. Each type of error (e.g., server failure, memory

access violation, device reply time-out, or message checksum error) shall be recorded separately with a date and time tag.

7. Server and peripheral device Errors

The Server/Device shall be declared as failed in case of fatal error. Server and peripheral device failure shall be detected and annunciated to the user within 10 seconds of the failure. For each type of recoverable error the programmer shall assign a threshold. When the count of consecutive recoverable errors exceeds this threshold, a warning message shall be issued to the operator.

8. Software Errors

Execution errors in on-line and maintenance functions that are not resolved by program logic internal to the function shall be considered fatal software errors. Examples of errors that may be resolved by internal program logic include failure of a study function to achieve a solution due to violation of an iteration limit or arithmetic errors (such as division by zero) which are caused by inconsistent input parameters or data. These errors shall produce an alarm informing the user of the error but shall not be considered fatal software errors. Fatal software errors shall result either in termination of the function or shall be handled as a fatal Server error. The action to be performed shall be defined by the programmer for each on-line function and each maintenance function. If the function is to be terminated, future executions of the function shall also be inhibited until the function is again initiated by the programmer.

On the occurrence of each fatal software error, Server and operating system error codes and messages shall be recorded in the SCADA/DMS-OMS system.

9. Server Redundancy and Configuration Management

Each server or server group supporting the CRITICAL functions described in the specifications, shall include at least one redundant server. The redundant server shall normally be assigned to the backup state and shall take the role of a primary server in the event of failure or upon user command.

When a failure of a primary server in a redundant group is detected, the SCADA/DMS-OMS computer system shall invoke the appropriate failover and restart actions so that on-line functions assigned to the failed server are preserved. The on-line functions of the failed primary server shall be assigned to the backup server by execution of a function restart within 30 seconds after detection of server failure, except for ISR function. For ISR server function the corresponding time shall be within 120 seconds after detection of server failure In case of failure of ISR sever, the ISR data shall be stored in the SCADA/DMS-OMS system till the failover of ISR server is completed to avoid data loss. This stored data shall be transferred to the ISR server automatically after restoration of ISR server.

If on-line functions are restarted in a backup server, the server's state shall be changed to primary. If backup servers are not available to perform the required functions, the SCADA/DMS-OMS computer system shall attempt to restart the failed primary server. A complete restart of the System, including full update from the field, shall not more than the stipulated time as specified above. No data shall be lost during the transfer of operation.

A failover (transfer of critical functions) to an alternate Server shall occur, as a minimum, under any one of the following situations:

i. Non-recoverable failure of a server performing a critical function
ii. User request for a transfer of servers

iii. Failure of a periodic / scheduled function to execute on schedule.
iv. Violation of a configurable hardware device error counter threshold.

Failure of non-critical function shall not cause server failover. Functions assigned to a failed server in a non-redundant group may be lost until the failed server is restored to service. Failure of server operating in the backup state shall not initiate failover action. Failed server shall be switched from down to any other state by user command only. All server reinstatement actions shall result in operator message. The messages shall identify the server(s) affected, all server state changes, and the success or failure of any restart operations.

10. Server Start-up

Server start-up shall be performed when commanded by a user, when server input power is interrupted and restored such that the operating environment of the server is established prior to restarting the on-line functions. Establishment of the operating environment may include execution of self-diagnostics, reloading the operating system and system services, and connection to and verification of communications with all nodes on the SCADA/DMS-OMS computer system LAN. Subsequent to server start-up, a function restart shall bring the server(s) to the appropriate server state.

Server Start-up requirements are as follows:

i. Cold Start: In which default values are used for entire database. A cold start would be used only to build the initial SCADA/DMS-OMS and to recover from extraordinary failure conditions. Server start-up shall be completed within 15 minutes and all applications shall be operational within 20 minutes of applying power except for ISR server and its database initialisation, which can be up to 60 minutes.
ii. Warm Start:In which a previously saved version of the database shall be used to initialise all real time data values. Server start-up shall be completed within 10 minutes and all applications shall be operational within 15 minutes of application of power.
iii. Hot Start: In which the memory resident version of database shall be used for continued operation. No reload of saved data shall be performed, although application software restarts. The intent is that after hot restart, only the operations being performed at the time of failure may be lost. All on line applications shall be operational not more than failover time.

11. Peripheral Device Redundancy and Configuration Management

The device failover shall result in an orderly transfer of operations to a backup device in the event of failure of primary device. The device failover function may replace a failed device with an identical backup device or with a backup device that is different from the normal device. Device failover actions shall be completed and the backup device shall be operating within 30 seconds of detection of the device failure. All device failures shall be annunciated by alarms.

12. System Configuration Monitoring and Control

Required displays shall be provided for the user to review the system configuration and to control the state of the equipment. The following operations shall be possible:

i. Fail-over, switching of states and monitoring of Servers and peripheral devices.
ii. Control of the resource usage monitoring function and display of server resource utilization
iii. The user shall be provided with the capability to interact with all functions using displays. It shall be possible to atleast Stop, Start, inhibit /enable and Restart any of the functions.
iv. Displays to view and control the status of backup databases shall also be provided.

E. TESTING & DOCUMENTATION

1. 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 Section 8.

2. Type testing –

Equipments 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 NABL 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.

3. Factory Acceptance Tests (FAT)

The SCADA/DMS system including DR centre ((DR is part of the project area) shall be tested at the Contractor's/SGIA's facility. All hardware and software associated with the SCADA/DMS system and atleast two RTUs alongwith , LDMS &10FRTUs & all Remote VDUs, shall be staged for the factory testing and all remaining RTUs /FRTUs/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, 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 mutual agreement for the same from owner.

4. 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.

5. 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 it's crashing/failure. The software deliverables shall include one copy of backup software on electronic media.

6. 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/FRTU/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 /FRTU/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 FRTU/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 /FRTU/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.

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)

In addition to the above tests the bidder/SGIA shall thoroughly test the system using the latest best practices and tool and techniques.

7. 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. IT system etc or any other systems as applicable. 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 of 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.

8. 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/FRTUs/FPIs along with all field devices including MFTs connected shall be tested under the field tests.

a. Field Installation Tests

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

The field installation test shall include the following:

i. Proper installation of all delivered hardware as per approved layout.
ii. Interconnection of all hardware
iii. Interconnection with communication equipments
iv. Interconnection with power supply
v. Diagnostic tests to verify the operation of all hardware
vi. Random checking of SCADA/DMS-OMS software basic functions

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

b. End-to-End Test

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

i. The communication of RTUs/FRTUS/FPIs/MFTs with SCADA/DMS system
ii. The RTU /FRTU/FPI communication channel monitoring in the SCADA/DMS system the mapping of SCADA database with RTU /FRTU/FPI database for all RTU /FRTU/FPI points.
iii. The mapping of SCADA database with displays and reports
iv. The Contractor shall provide the details of all the variances observed and corrections carried out during end to end test.

c. 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/FRTU/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:

i. The communication of other system i.e IT , SLDC, DR system with SCADA/DMS system.
ii. Mapping of SCADA/ISR database with other system database viz IT , SLDC, DR system.
iii. Verify that all the variances observed during the Factory test are fixed and implemented.
iv. Conduction of the Factory tests deferred (tests requiring site environment)
v. Functional tests of SCADA/DMS system
vi. Verify the execution rates of all SCADA/DMS application
vii. Verify update rate & time for data update & control command execution as per specification requirements
viii. Verify the response time of all SCADA/DMS applications.
ix. Verify the response time for User interface requirements
x. 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.
xi. Conduction of unstructured tests as decided by the Employer

9. 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/FRTU/FPIs and IT SYSTEM . However, the non-availability of RTUs/Data Concentrators/ FRTU/FPI,IT system etc & Communication System shall not be considered for calculating system availability. However, RTU/FRTU, communication equipments , Auxiliary power supply shall be tested as per the provisions given in their chapters.

The SCADA/DMS-OMS 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/FRTUs shall be conducted along with System availability test for 360 hours. Each RTU/FRTUs shall exhibit minimum availability of 98%. In case the RTU/FRTU availability falls short of 98%, the contractor shall be allowed to repeat the RTU/FRTU availability test (for failed RTU/FRTU 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-OMS system and RTUs/FRTU/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-OMS applications are functional to ensure the design & performance requirement as envisaged in the specification
b. Atleast one of the operator console is available
c. Atleast 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
j. 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.

Downtime

Downtime occurs whenever the criteria for successful operation are not satisfied. During the test period , owner/Purchaser shall inform the Contractor/SGIA for any failure observed. For attending the problem the contractor/SGIA 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.

Holdtime

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 the purpose of measuring SCADA/DMS availability. Such periods of unsuccessful operation may be declared "holdtime" by mutual 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.

Documentation

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 customised documents for SCADA/DMS in 2 sets for review/approval by the Employer for necessary reference which includes the following:

a. System overview document
b. Cross Reference Document
c. Functional design document
d. Standard design documents
e. Design document for customisation
f. System Administration documents- software utilities, diagnostic programs etc.
g. Software description documents
h. Bill of Quantity & List of software and hardware deliverable
i. protocol implementation documents
j. point address document
k. IP addressing plan document
l. Software User document for dispatchers
m. Software Maintenance document
n. Training documents
o. Real time & RDBMS documents
p. Database settings, Displays and Reports to be implemented in the system
q. Test procedures
r. Test reports
s. Hardware description documents
t. Hardware User documents
u. Hardware Maintenance documents
v. Data Requirement Sheet (DRS) of all Hardware
w. Site specific Layout, Installation, GA, BOQ, schematics and cabling details drawings/documents
x. SCADA & IT Integration Plan Document using CIM/XML Adapters & Messaging Interfaces.
y. Cyber Security Plan & Mitigation document for the system if Public Networks are used.
z. Interoperability profiles/ Tables

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 this backup software shall be submitted to the owner.