(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

OPTCL
Lifeline of Odisha

For

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

Volume-II

(Technical Scope, Functional Requirement and Service Level Agreement)

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May 2nd, 2019

A. Definitions and Abbreviations

1. Definitions

1.	**"AMI"**	:	"Advanced Metering Infrastructure (AMI)" including smart meters means the infrastructure required to enable the Distribution Licensee to accurately collect, monitor and analyse real-time consumption data from consumers, communicate price signals to consumers and where permitted control load
2	**"Smart Grid Implementing Agency" or**	:	Same as "Project Implementing Agency"
3.	**"AMR"**	:	"Automated Meter Reading (AMR)" means the infrastructure required to enable the Distribution Licensee to accurately collect consumption data from consumers.
4.	**"Bid(s)"**	:	The bid submitted by the Bidder(s) in response to this RFP.
5.	**"Bidder(s)"**	:	A company or a consortium of member companies (not exceeding 3) represented by Lead member bidding in response to this RFP
6.	**"Bidding Consortium"**	:	The Consortium of member companies (not exceeding 3) legally bound as per the terms and formats of this RFP to bid for the Project.
7.	**"Consortium Member"**	:	Any Member of the Bidding Consortium other than the Lead Consortium Member.
8.	**"Contract"**	:	The Agreement between PFCCL and the Successful Bidder upon receiving the Letter of Award from PFCCL for implementation of the Project.
9.	**"Employer"**	:	Same as the "Project Management Agency" or PMA
10.	**"Financial Year" or "FY"**	:	Period starting from 1 April of the first calendar year to 31 March of the consecutive calendar year.
11.	**"FMS"**	:	Facility Management Service
11.	**"Lead Consortium Member"**	:	The Consortium Member taking the lead in submitting this RFP in terms of **Clause 8 of Section F i.e. G.C.C** of this RFP and duly supported by the legal agreements as per formats in this RFP.
12.	**"MTS"**	:	Minimum Technical Standards as defined in Volume 2 of this RFP.

3.	**PFCCL**		PFC Consulting Ltd. (a wholly owned subsidiary of Power Finance Corporation)
14.	**"Party" or "Parties"**	:	PFCCL, OPTCL, and the SGAI
5.	**"Price Bid"**	:	Price Bid refers to the price quoted against Bill of Quantity and Percentage of Incremental Revenue (arising out of reduction of AT&C Losses) to be shared by the Bidder with the Utility.
16.	**"Project"**	:	OPTCL's Smart Grid Project in Rourkela.
17.	**"Project Implementing Agency" or "Contractor" or "PIA or "SGIA"**	:	The bidder appointed by PFCCL upon signing of the Contract subsequent to the Letter of Award for implementing the Smart Grid Project in Rourkela.
18.	**"Project Management Agency" or "PMA"**	:	PFCCL which has been appointed as Project Management Agency by OPTCL for bid process management for selection of SGIA, project monitoring during construction and O&M period up to transferring of the Smart Grid Project to OPTCL.
19.	**"Request for Proposal" or "RFP"**	:	This Tender No. SG/Rourkela/SGIA including all its Volumes for Appointment of Smart Grid Implementing Agency (including all clarification/ addendum/ amendment/ corrigendum/ etc. issued from time to time)
20.	**"Rupees" or "Rs." Or "INR"**	:	Indian Rupees
21.	**"Service(s)" or "Related Service(s)"**	:	Any service(s) performed or to be performed as a part of the project by the Contractor.
22.	**"Smart Meter"**	:	Smart meters are composite unit consisting of metrology elements, two-way communication module/modules. It has functioned such measurement, computation, event capturing, storing, communication and control
23.	**"Solution"**	:	The system within the Scope of Work of the Project as defined by this RFP and implemented in its entirety including but not limited to the supply of hardware, transportation, software, installation, integration, testing, commissioning, training operation, maintenance and other services by the SGIA.
24.	**"Successful Bidder"**	:	Successful Bidder shall be the Bidder sharing highest Percentage of Incremental Revenue (arising out of reduction of AT&C Losses) with utility
25.	**"Technical Score"**	:	The score determined in the technical evaluation of the bids based on the provisions provided in Tender Evaluation Methodology

26.	**"Tender"**	:	Same as "RFP"
27.	**"TPIEA"**	:	Third Party Independent Evaluation Agency which has carried out baseline KPI study.
27.	**"Utility"**		Utility means Western Electricity Supply Company of Odisha (WESCO)

2. Abbreviations

1.	**ADMS**	Advanced Distribution Management System
2.	**AMI**	Advanced Metering Infrastructure
3.	**AMI-IA/AIA**	Advanced Metering Infrastructure – Implementation Agency
4.	**BG**	Bank Guarantee
5.	**BoM**	Bill of Material
6.	**BoQ**	Bill of Quantity
7.	**CC**	Control Circuit
8.	**CIM**	Common Information Model
9.	**CMMI**	Capability Maturity Model Integration
10.	**CV**	Curriculum Vitae
11.	**DCU**	Data Concentrator Unit
12.	**FMS**	Facility Management Services
13.	**FRTU**	Field Remote Terminal Unit
14.	**GPRS**	General Packet Radio Service
15.	**GST**	Goods and Services Tax
16.	**HES**	Head-End System
17.	**IPR**	Intellectual Property Rights
18.	**ISO**	International Organization for Standardization
19.	**IT**	Information Technology
20.	**OPTCL**	Odisha power Transmission Corporation Limited
21.	**MDM**	Meter Data Management
22.	**MTS**	Minimum Technical Standards
23.	**NIC**	Network Interface Controller
24.	**P&L**	Profit & Loss
25.	**PAN**	Permanent Account Number
26.	**PF**	Provident Fund

27.	**PFCCL**	Power Finance Corporation Consulting Limited
28.	**PLC**	Power Line Communication
29.	**PMA**	Project Management Agency
30.	**PO**	Purchase Order
31.	**PON**	Power Outage Notification
32.	**PRN**	Power Restoration Notification
33.	**RF**	Radio Frequency
34.	**RFP**	Request for Proposal
35.	**RTI**	Right to Information
36.	**RTU**	Remote Terminal Unit
37.	**SI**	System Integrator OR System Integration
38.	**SLA**	Service Level Agreement
39.	**WO**	Work Order
40.	**XML**	Extensible Mark-up Language
41.	**SGIA**	Smart Grid Implementing Agency

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B. INTRODUCTION AND GENERAL INFORMATION

B.1. Introduction

Global energy scenario is witnessing key changes in terms of shift of focus towards green energy and sustainable growth and SMARTGRID is getting evolved by integrating end-to-end, advanced communications infrastructure and information systems into the electric power system. Objective of Smart Grid is to use advancements of information and communication technology to make the power grid more efficient, reliable, secure and resilient while minimizing costly investments in new centralized generation capacity. One of the main points about Smart Grid is an increased level of observation and control of a complex power system to facilitate distributed and renewable energy generation. This can only be achieved by an increased level of information sharing between the individual components and sub-systems of the power system. Standardization plays a key role in providing the ability of information sharing which will be required to enable the development of new applications. Smart Grid can provide consumers near real-time information on their energy use, support pricing that reflects changes in supply and demand, and enable smart appliances and devices to help consumers exercise choices in terms of usage of energy. Utilities can better manage the grid in terms of increased visibility of network, improved billing and realization efficiency, increased availability of grid and access of power to rural areas.

The Smart Grid is integrating the electrical and information, communication technologies in the complete power system value chain enabling every point for generation and every point as controllable consumption.

This section gives information on the existing systems at OPTCL/WESCO in order to assist the Bidder to understand the existing environment and plan the integration of the Smart Grid Solution with the legacy system. Different IT & Operations Technology (OT) systems have been implemented under various initiatives of OPTCL to monitor and operate power system network and to manage different business process and daily activities. Following sections give details on the existing infrastructure owned by the OPTCL or under implementation, which shall be integrated and operated with the proposed Solution under the Scope of Work.

B.2. Background

OPTCL has appointed PFCCL as the “Project Management Agency (PMA)” or the “Employer” for designing, financing, implementing, operating and transferring the Smart Grid Project in its area of operation. PMA will appoint the Smart Grid Implementation Agency (on behalf of OPTCL), finance the project and manage the entire project deployment and its operations. The project will be transferred to the OPTCL at no cost at the end of the project period. The PMA will interface with both the OPTCL and Contractor. As such, the Contractor will be interfaced with the PMA from both project implementation and contractual purposes. The roles and responsibilities of the Contractor and payment thereof are governed by the Terms and Conditions of this RFP.

The Terms and Conditions of this RFP have been defined considering a large-scale implementation of AMI project. It is therefore preferred, that this RFP be applicable for installation size of minimum 81,000 Smart Meters

B.3. Project Objective

The objective of the RFP is to select contractor for supply, installation, testing, commissioning and maintenance of Advanced Metering Infrastructure, including smart meters, communication infrastructure along with applications for Head End System (HES), Meter Data Management (MDM) System. The project shall also include integration of HES with MDMS and MDMS with existing OPTCL applications as defined in this specification document.

The key strategic objectives for AMI implementation include:

a. **Achieve Operational Efficiencies**: Reduced operating costs in areas such as meter reading and punching, connection/disconnection, consumer complaints, reduced float between meter reading and bill generation
b. **Revenue Protection**: Reduced commercial loss with accurate energy accounting, detection of meter tampering and improved meter reading accuracy
c. **Improved Load and Power Quality Management**: Better visibility of loading and power quality factors on the transformers to enable accurate capacity planning and prevention of failure/under-utilization of asset
d. **Faster Outage Detection**: Near real time notification outages to enable faster detection and restoration
e. **Keep Customer Bills Low:** achieving the conservation benefits, operational efficiencies, and revenue protection lead to OPTCL rate reductions which translate directly into customer savings.
f. **Improved Customer Service**: Provide near real-time, accurate and detailed information on consumption, cost and outages
g. **Achieve Energy Efficiency:** Ability to monitor electricity consumption in near real time, consumers can manage consumption to achieve energy efficiency and save money
h. **Achieve Environment and Social Benefits:** Facilitating energy efficiency, improved load management and reduced commercial losses to enable reduced greenhouse gas emissions
i. **Support Advanced Customer Applications:** provide a substantial portion of the foundational infrastructure required to modernize the grid in support of advanced customer applications such as distributed generation, electric vehicles, demand response, micro-grids, and future applications.

These additional features should also be considered

a. Energy audits can be done at distribution transformer level as per desired frequency to check leakage and pilferage
b. Load pattern of individual consumer can be observed
c. Withdrawal of power above sanctioned load may be monitored and controlled
d. Tampering may be checked in near real time
e. Control actions from control centre for load curtailment may be taken
f. Sending alert to consumer for higher load withdrawal, bill non-payment etc.
g. Signal transmission for variable pricing,
h. Customer participation in demand response programmes

B.4. About OPTCL

Rourkela is one of Odisha's five major cities and is one of the largest urban centers located in Chota Nagpur Plateau and an important industrialized city of the region. The region has a rich and long history of indigenous settlement (Tribes like Oraons, Mundas, Kharias, Bhuiyans and Bhumijs). It is also one of the two proposed smart cities from the State of Odisha; selected by the GoI and it is the Steel City of Odisha. It has an area of 53.29 km² and its location provides a Railway gateway for access to Eastern Part of India to Southern Part of India and Western Part of India. The population of Rourkela is over 3.09 lakhs and power consumers are over 81,000 nos. As per Baseline KPI study carried out by Third Party Independent Evaluation Agency (TPIEA) AT&C losses are around 35%. Consumers in Rourkela get electricity from Western Electricity Supply Company of Odisha (WESCO), one of the distribution utilities catering to Western part of Odisha with headquarters at Burla.

WESCO is power distribution OPTCL distributing electricity to the consumers of western part of Odisha covering 9 revenue District namely Sambalpur, Bargarh, Jharsuda, Deogarh, Sundargarh, Subarnapur, Bolangir, Kalahandi and Nuapada etc. For smooth functioning of OPTCL, activities is divided into 5 circles comprising different revenue Districts.

a. Sundargarh District- Rourkela Circle

b. Jharsuguda & Sambalpur District- Sambalpur Circle

c. Bargarh District- Bargarh Circle

d. Subarnapur & Bolangir District- Bolangir Circle

e. Kalahandi & Nuapada District- Kalahandi Circle

Rourkela is divided into mainly 2 urban centers – Rourkela Municipal Corporation (RMC) with an area of 53.3 Sq Kms and the Rourkela Steel Township (RST) with an area of approximately 54 Sq Kms.

Known as the Steel City, with the presence of SAIL's first Integrated Steel Plant; further Rourkela Industrial Area has 43 Sponge Iron Plants, 3 cement industries and around 350 MSMEs'. However, for implementation of Smart Grid, the following have been excluded:

a. Area of Rourkela Steel Plant and its residential areas

b. Area of Railway and its residential colony

c. Area of National Institute of Technology (NIT) and, its residential colony

Table 1: Details of Project Area

S.No.	Particulars	Unit	Details
1	Project Area		ROURKELA
2	Area of Coverage	Sq. Km.	53.29 sq. KM
3	No. of Division Offices in the Project Area	Nos.	3
4	No. of Sub-Division Offices in the Project Area	Nos.	7
5	Population	Nos.	~3.09 lakhs
6	Consumers	Nos.	~81,000

B.4.1. Network Details

Table 2: Existing Network Details

Sr. No.	Particulars	Unit	RED	RSED	RJP	Total
1	**33 KV Substation (MVA)**	**MVA**	**79**	**91.08**	**23**	**198.85**
2	**33 KV line length (CKT KM)**	**Ckt Km**	**38.9**	**33.96**	**NIL**	**71.81**
3	**11 KV line (CKT KM)**	**Ckt Km**	**109.23**	**89.87**	**25.83**	**224.93**
4	**LT line (CKT KM)**	**Ckt Km**	**168.65**	**157.85**	**43.71**	**370.21**
5	**Capacity of 11/0.4 KV distribution T/F (MVA)**	**MVA**	**78.88**	**67.51**	**16.97**	**163.36**
6	**No of 11/0.4 KV distribution T/F**	**Nos**	**647**	**428**	**108**	**1180**
7	**Capacity of 33/0.4 KV distribution T/F (MVA)**	**MVA**	**3**	**NIL**	**NIL**	**3**
8	**No of 33/0.4 KV distribution T/F**	**Nos**	**9**	**NIL**	**NIL**	**9**

B.4.2. Consumer Data

The Cumulative Annual Growth rate (CAGR) has been calculated for category wise consumers, connected load and energy sales based on the consumer data of last 5 years (i.e. FY 2012-13 to FY 16-17). The details of the same has been mentioned below:

Table 3: PROJECTED GROWTH OF CONSUMER, LOAD AND SALES

Consumers (Nos.)	FY 12-13	FY 13-14	FY 14-15	FY 15-16	FY 16-17	CAGR
Domestic	53,127	56,737	59,448	62,165	65,595	5.41%
LIGH	1	2	49	78	32	
Commercial	9,099	9,495	9,913	10,464	11,045	4.96%
Agriculture	10	15	15	12	13	6.78%
LT Industry	435	426	426	433	441	0.34%
HT/EHT Industry	51	50	52	54	55	1.91%
Public Lighting	5	6	6	10	10	18.92%
Public Water Works	12	16	16	20	21	15.02%
Temp. Supply	0	0	0	0	0	0.00%
Total	62740	66747	69925	73236	77212	

Connected Load (KW)	FY 12-13	FY 13-14	FY 14-15	FY 15-16	FY 16-17	CAGR
Domestic	41,304	53,149	55,822	58,739	63,266	5.98%
LIGH	1	0	0	0	1	
Commercial	8,745	10,153	10,749	11,528	12,439	7.00%
Agriculture	153	185	188	190	207	3.82%
LT Industry	6,202	6,865	6,702	6,884	7,339	2.25%
HT/EHT Industry	6,215	6,267	6,485	6,679	6,791	2.71%
Public Lighting	422	504	519	871	908	4.30%
Public Water Works	557	693	692	792	718	1.19%
Temp. Supply	0	0	0	0	0	0.00%
Total	63599	77816	81157	85683	91669	

ENERGY SALES (MUs)	FY 12-13	FY 13-14	FY 14-15	FY 15-16	FY 16-17	CAGR
Domestic	93	102	117	136	143	5.00%
ENERGY SALES (MUs)	FY 12-13	FY 13-14	FY 14-15	FY 15-16	FY 16-17	CAGR
LIGH	0	0	0	0	0	5.00%
Commercial	26	28	30	36	38	10.72%
Agriculture	0	0	0	0	0	10.06%
LT Industry	5	6	6	6	6	3.15%
HT/EHT Industry	34	58	60	58	60	0.84%
Public Lighting	2	2	2	3	4	27.15%
Public Water Works	1	1	1	1	1	10.67%
Temp. Supply	0	0	0	0	0	0.00%
Total	160	197	215	241	252	

Table 4: Projected Number of Consumers (Nos.)

Consumers (Nos.)	FY 16-17	FY 17-18	FY 18-19	FY 19-20	FY 20-21	FY 21-22	FY 22-23	FY 23-24	FY 24-25
	Actual	Projected	Projected	Projected	Projected	Projected	Projected	Projected	Projected
Domestic	65,595	69,145	72,887	76,831	80,989	85,372	89,992	94,862	99,996
LIGHT	32	32							
Commercial	11,045	11,593	12,169	12,773	13,407	14,073	14,771	15,505	16,275
Agriculture	13	14	15	16	17	18	19	21	22
LT Industry	441	443	444	446	447	449	450	452	453
HT/EHT Industry	55	56	57	58	59	60	62	63	64
Public Lighting	10	12	14	17	20	24	28	34	40
Public Water Works	21	24	28	32	37	42	49	56	64
Temp. Supply	0								
Total	77212	81319	85614	90173	94976	100038	105371	110992	116914

Table 5: Projected Connected Load (KW)

Connected Load (KW)	FY 16-17	FY 17-18	FY 18-19	FY 19-20	FY 20-21	FY 21-22	FY 22-23	FY 23-24
	Actual	Projected	Projected	Projected	Projected	Projected	Projected	Projected
Domestic	63,266	67,050	71,060	75,309	79,813	84,587	89,645	95,007
LIGHT	1	1	1	1	1	1	1	1
Commercial	12,439	13,310	14,243	15,240	16,307	17,449	18,671	19,979
Agriculture	207	215	223	232	240	250	259	269
LT Industry	7,339	7,504	7,673	7,845	8,022	8,202	8,387	8,575
HT/EHT Industry	6,791	6,975	7,164	7,359	7,558	7,763	7,974	8,190
Public Lighting	908	947	988	1,030	1,075	1,121	1,169	1,219
Public Water Works	718	727	735	744	753	762	771	780
Temp. Supply	0	0	0	0	0	0	0	0
Total	91669	96729	102086	107760	113769	120134	126877	134020

Table 6: Projected Energy Sales (MUs)

Sales	FY 16-17	FY 17-18	FY 18-19	FY 19-20	FY 20-21	FY 21-22	FY 22-23	FY 23-24
	Actual	Projected	Projected	Projected	Projected	Projected	Projected	Projected
Domestic	143	150	158	165	174	182	192	201
LIGHT	0	0	0	0	0	0	0	0
Commercial	38	42	47	52	57	64	70	78
Agriculture	0	0	0	0	0	0	1	1
LT Industry	6	6	7	7	7	7	7	8
HT/EHT Industry	60	60	61	61	62	62	63	63
Public Lighting	4	5	6	7	9	12	15	20
Public Water Works	1	1	1	1	1	1	2	2
Temp. Supply	0	0	0	0	0	0	0	0
Total	252	265	279	294	311	329	349	372

B.4.3. Formation of Data Recovery Centre (DRC) (N-1 Redundancy):

Due to the sub-tropical littoral location, Odisha is vulnerable to multiple disasters like tropical cyclones, storms, tsunamis and floods. Although earthquakes are not so common, their effect can't be ignored as the Brahmani-Mahanadi and their deltaic areas come under Earthquake Risk Zone-III (Moderate Damage Risk Zone).

Rourkela and Bhubaneshwar are in two different Seismic Zones. In view of the same, a DRC is proposed at Bhubaneswar with n-1 redundancy of Smart Grid Control Centre (SGCC) at Rourkela. The Data link between the DR at Rourkela and DRC at Bhubaneswar could be established by using the OPTCL Fiber Network deployed across the state of Odisha.

Table 7: Asset Information of the Project Area

S. No.	Particulars	Unit	Value
1	Total No. of 33 KV Sub-stations feeding the Project Area	Nos.	14
2	Total Number of Power Transformers at 33 KV S/S	Nos.	30
3	Total Capacity of Power Transformers at 33 KV S/S	MVA	198.85
4	Total Number of 33 kV Feeders	No.	10
5	Total Length of 33 kV Feeders	Kms	71.81
6	Total Number 11 kV Feeders	Nos.	31
7	Total Length of 11 kV Feeders	Kms.	224.93
8	No of 33KV/ 0.4 KVA DT	Nos	9
9	Capacity of 33KV/0.4 KVA DT	MVA	3
10	Total Length of LT Lines	Kms.	370.21
11	Total Number of Distribution Transformers	Nos.	1180
12	Total Capacity of Distribution Transformers (11KV/ 0.4 KV)	MVA	163.36

Table 8: Key Performance Indicators of the Project Area (Commercial + Operations)

S.No.	Particulars	Unit	FY 2015-16	FY 2016-17
1	Total Consumers	Nos.	67266	70339
2	Annual Input Energy	in MU	301.708	315.845
3	Annual Energy Billed	in MU	221.636	213.640
4	Total Revenue Billed	in Rs. Crores	119.34	115.94
5	Total Revenue Realized	in Rs. Crores	102.09	111.40
6	Billing Efficiency	%	73%	68%
7	Collection Efficiency	%	86%	96.09%
8	AT&C Losses	%	37%	31.54%
9	Average Billing Rate	in Rs. / KWH	5.38	5.43
10	Annual Consumer Base Growth	%	3%	5%
11	Peak Demand	in MW	85	85
12	DT Failure Rate	%	11%	10%
13	HT / LT ratio	Nos.	-	0.60
14	Provisional Billing	%	14%	7%
15	Defective Meter	%	8%	9%
16	Disconnection/Re-connection	Nos	1050	1080

Table 9: Metering Type of the Project Area (2016-17)

S. No	Particulars	Nos. of Metering Points.	Annual Consumption (in MU)	% of Overall Consumption
1	Single Phase Meters	77822	129.058	60%
2	Three-Phase Meters	3624	45.2871	21%
3	LT-CT Meters for consumers	76	0.0309	0%
4	HT Meters	63	39.264	18%
5	DT Meters	1180		
	Sub-Total	82437	213.64	100%

Table 10: Substation / Feeder Details

DIVISION	S.No.	33 KV FEEDER NAME	FROM SS STATION NAME	TO SS STATION NAME (33/11kV S/S)	Name of 11 KV Feeder	No of DT	No of Consumers
RED	1.	Industrial Estate	132/33 kV Rourkela Grid Sub-station , 4 X 35 MVA	Industrial Estate, (8X1) + (6.25 X 1) MVA	11 kV Town Feeder	25	1341
					11 kV Industrial Estate Feeder	74	3145
	2.	PHD	132/33 kV Rourkela Grid Sub-station , 4 X 35 MVA	Panposh (5X1) + (8X1) MVA	RAW Water Feeder	23	1221
					11 kV Town Feeder	77	3939
					PHD	3	68
					RGH	2	2
					College	40	3010

DIVISION	S.No.	33 KV FEEDER NAME	FROM SS STATION NAME	TO SS STATION NAME (33/11kV S/S)	Name of 11 KV Feeder	No of DT	No of Consumers
	3.	Lathikatha	132/33 kV Rourkela Grid Sub-station, 4 X 35 MVA	Lathikata (5X1) + (8X1) MVA	Modern India II	10	432
	4.	Pilot PROJECT	132/33 kV Rourkela Grid Sub-station, 4 X 35 MVA	Pilot PROJECT, (1.6 X 1) MVA	Pilot Project Feeder	1	37
	5.	Power House	132/33 kV Rourkela Grid Sub-station, 4 X 35 MVA	Power House (8 X 2) + (5X1) MVA	11 kV Main Road	40	3841
					11 kV PH Road	14	1512
					11 kV Plant Site	22	3915
					Uditnagar	47	4387
RSED	1.	Chend	132/33 kV Chhend Grid - Sub-Station, 3 X 40 MVA	Chend (5X 2) + (8X1) MVA	11 kV Kalingvihar Feeder		2521
					11 kV Laukera Feeder	30	1251
					11 k V Phase - I Feeder	34	3798
					11 kV RDA	22	1748
					Self-Finance	20	2049
					11 kV Panposh Feeder	28	1728
	2.	Basanti	132/33 kV Chhend Grid - Sub-Station, 3 X 40 MVA	Basanti (8 X 2) MVA	11 kV DAV	21	4261
					11 kV MS Palli	51	4711
					11 kV PHD feeder	20	3121
	3.	Koel Nagar	132/33 kV Chhend Grid -	Koel Nagar (5 X 1) + (8 X 1) MVA	11 kV ADE Feeder	29	3680
					11 kV BC Feeder	18	1787

DIVISION	S.No.	33 KV FEEDER NAME	FROM SS STATION NAME	TO SS STATION NAME (33/11kV S/S)	Name of 11 KV Feeder	No of DT	No of Consumers
			Sub-Station, 3 X 40 MVA		11 kV Jhirpani	20	1760
					11 kV Hamirpur Feeder	68	2900
	4.	NIIT	132/33 kV Chhend Grid - Sub-Station, 3 X 40 MVA	NIIT/REC (5X2) + (8 X 1) MVA	11 kV OSAP	138	4533
					11 kV Jagda Feeder	40	3421
					11 kV Nayabazar Bondamunda Feeder	118	7463
	5.	Vedvayas	132/33 kV Chhend Grid - Sub-Station, 3 X 40 MVA	Vedvayas (8X1) + (5X1) MVA	Vedvyas	71	2745
					Goppally	37	1119
				Bondamunda (8 X 2) MVA			
				Kalinga Vihar (8X2) MVA			
				Civil Township (8X2) MVA			
				Gopobandhupally (5x2) MVA			

B.4.4. Details of existing IT Application at OPTCL:

Table 11- Details of existing IT application to be Integrated with new system

Application Name & functional description	OS	Database	Any runtime license ex, Testing tools	Location of Resources	Number of Concurrent Users (High:100+, Med:10-100, Low:<10)
Android Based Spot Billing for single phase	Android	Sql Server	Sql Server	Bhubaneswar	High
EBS- Non-SBM Billing System for Single Phase (In Contingency State),3	Windows-2003	Oracle	Oracle	Burla	Low
Online Cash and Digital Payment Collection Management Module (SinglePhase&3Phase)"	Windows-2008 Server	Sql Server	.Net, Sql Server	Bhubaneswar	High

Application Name & functional description	OS	Database	Any runtime license ex, Testing tools	Location of Resources	Number of Concurrent Users (High:100+, Med:10-100, Low:<10)
Billing and Payment information to the high value consumers through e-Mail and SMS	Windows-2003 Server	Oracle	Oracle	Burla	Low
CWTT (Consumer wise Transformer Tagging)	Windows-2003 Server	Oracle	Oracle	Burla	Low
Mi-Power software for Consumer-Indexing based energy audit.	Windows-2003 Server	Oracle	Oracle	Burla	Low
ASD Software-Additional Security Deposit Calculation and Notifications	Windows-2003 Server	Oracle	Oracle	Burla	Low
Software workflow for requisition of meters for 3- phase consumers from requisition to installation process handling	Windows-2008 Server	Sql Server	.Net, Sql Server	Bhubaneswar	High
Tally Software	Windows		Tally License	All Offices	Med
Collaboration with SREI Sahaj e-Village Limited for Bill Collection in remote areas operated by OCAC. (IT Integration provided at division level)	Windows-2008 Server	Sql Server	.Net, Sql Server	Bhubaneswar	High
Online Bill Payment through web via <www.orissaonline.gov.in> (OCAC/ OeSL) (IT Integration provided at division level)	Windows-2008 Server	Sql Server			
Reports, Statistics and Data Analysis	Windows-2008 Server	Sql Server	.Net, Sql Server	Bhubaneswar	High

Application Name & functional description	OS	Database	Any runtime license ex, Testing tools	Location of Resources	Number of Concurrent Users (High:100+, Med:10-100, Low:<10)
Billing Engine (Revenue Assurance Module)	Windows-2003 Server	Oracle	Oracle	Burla	Low

B.5. Selection of Technology & Solution for Implementation

Based on the discussions with stakeholders from OPTCL/ WESCO and PFCCL, the following technology is being proposed for Smart Grid implementation:

a. AMI (Based on Sub-Ghz RF)
b. SCADA/DMS/OMS
c. DT Monitoring
d. Control center at Rourkela and DR Centre at Bhubaneswar or Burla (To be decided by High Level Committee from GRIDCO/ WESCO/ OPTCL.

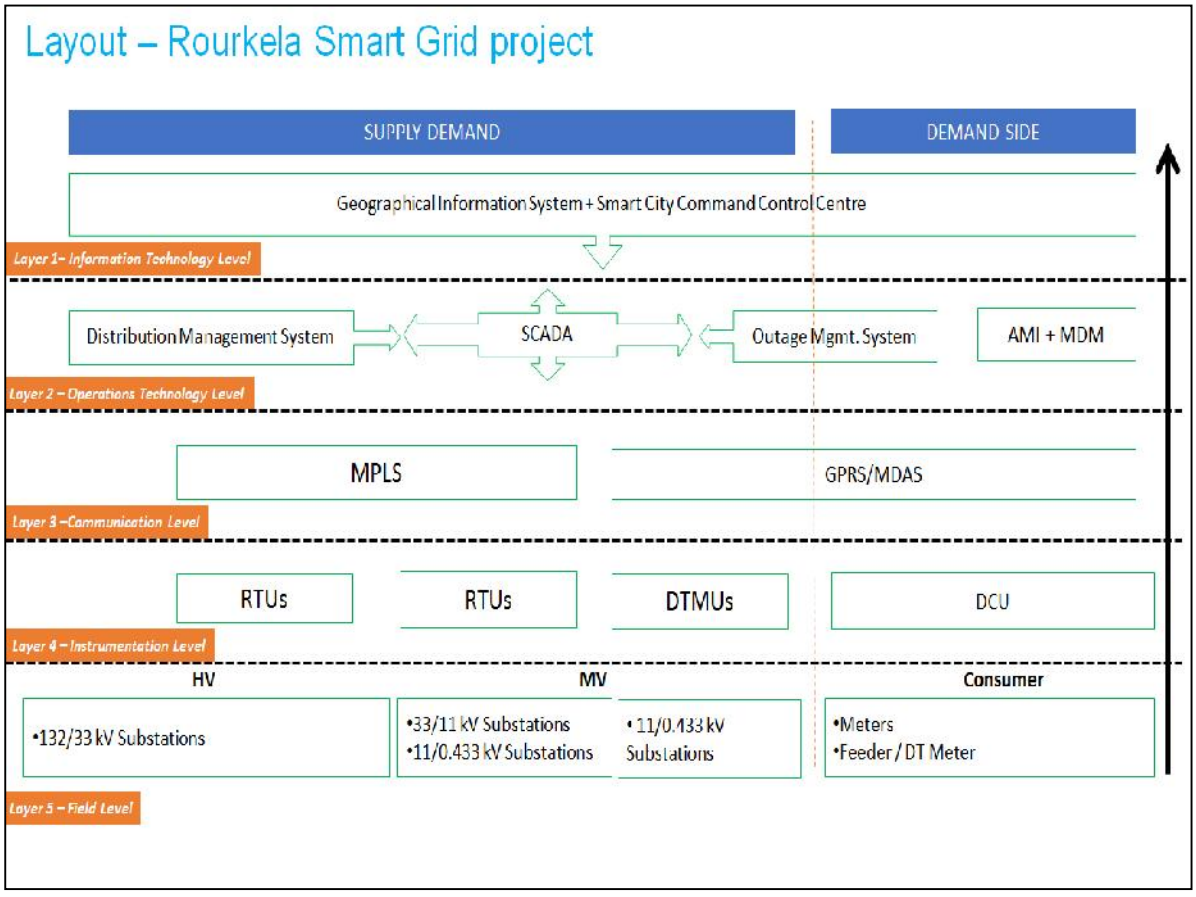


Figure 1: Proposed Architecture

B.6. Proposed Architecture

The architecture for Smart Grid infrastructure is proposed to have bi-directional communication having 5 layers wherein the Field Devices - Energy Meter/ Sub-Stations shall communicate via suitable

field communication devices like DCUs/ RTUs and chosen Publically Available Communication Mode to the AMI System/ SCADA System.

For visualization, GIS shall be on top of the Layer where all data from AMI and SCADA system shall be visible. The Layout has been designed as per the flow of Communication from field devices to Visualisation engine which is the GIS System.

SCADA system shall be supervised by the Data Management System (DMS) and Outage Management System (OMS) which will have all the logics of controlling the Distribution Network. Similarly, the AMI will be supervised by the Meter Data Management (MDM) which will have all the logics and control.

The Consumer and the Network data for analysis and effective visualization will be available in the GIS System in the Control Centre. The Control Centre will have a remote disaster data back up at a remote location suitably in Bhubaneswar.

C. GENERAL REQUIREMENTS

C.1. General Responsibilities and Obligations

The Bidders must conform to the requirements and provide a list of equipment (including any special equipment) necessary to meet the functional & performance requirements stated herein. It should be noted that preliminary design information and Bill of Quantity (BoQ) specified in this specification are indicative only except the quantities of smart meters. The Bidders shall verify the design data during the site surveys & detail engineering and finalize the BOQ as required for ultimate system design & development to meet performance requirements.

Bidder shall submit Clause by Clause compliance to the Technical Specifications (forming part of RFP Document read in conjunction with amendments, if any. Deviation if any shall be clearly mentioned.

The bidder's proposal shall address all functional and performance requirements within this specification and shall include sufficient information and supporting documentation in order to determine compliance with this specification without further necessity for inquiries.

Bidder may provide all applications in one suite or multiple modules to meet all the Technical Specification requirements. The bidder's proposal shall clearly identify all features described in the specifications or in any supporting reference material that will not be implemented; otherwise, those features shall become binding as part of the final contract.

An analysis of the functional and performance requirements of this specification and/ or site surveys, design, and engineering may lead the Bidders to conclude that additional items (for example communication repeater, router etc.) are required that are not specifically mentioned in this specification. The Bidders shall be responsible for providing at no added cost to the Employer, all such additional items such that a viable and fully functional AMI system is implemented that meets or exceed the capacity and performance requirements specified. Such materials shall be considered to be within the scope of the contract. To the extent possible, the bidder shall identify and include all such additional items in their proposal.

The offered items shall be designed to operate in varying environments. Adequate measures shall be taken to provide protection against contaminants, pollutants, rain water & moisture, lightning & short circuit, vibration and electro-magnetic interference etc. The Bidders shall demonstrate a specified level of performance of the offered items during well- structured factory and field tests.

All equipment provided shall be designed to interface with other equipment and shall be supporting all present requirements and spare capacity requirement identified in the Technical Specifications.

The Bidders are advised to visit sites (at their own expense), prior to the submission of the proposal, and make surveys and assessments as deemed necessary for proposal submission. The successful Bidder (Contractor) shall be required to visit project area for detailed site surveys for performing the design and implementation functions.

After the site survey the Contractor shall submit a survey report. This report shall include at least the following items (however, the exact parameter for survey & format of the survey report shall be finalized by the Contractor with the approval of PFCCL/OPTCL:

a. Proposed routing of power, earthing, communication signal cables including trenches etc.
b. Tentative location of devices/equipment for setting up communication network.
c. Consumer indexing of the project area (mapping of consumers (including their GPS coordinates) with DTs and Feeder)
d. Confirmation of adequacy of space and AC power supply requirements.

e. Identify all additional items required for interconnection with the existing/owner provided equipment/facilities
f. Verification of all integrations with external systems as mentioned in the RFP
g. Requirement of modification to existing earthing arrangement of control centre and locations where communication equipment / devices etc. are to be installed, if any.

C.2. Access to OPTCL Facilities

PFCCL to facilitate through the OPTCL management, safe and reasonable access to OPTCL premises for contractor's personnel and third-party vendors. This facilitation shall include, space for data centers, working space including air conditioning, light, ventilation, electric power and outlets. The contractor's personnel shall comply with all applicable rules, regulations and requirements relating to visitors on the premises of OPTCL.

C.3. Responsibilities for the Implementation Plan

The bidder's technical proposal shall include a project implementation plan and schedule spread over 24 months from date of commencement that is consistent with the implementation plan detailed in this specification along with FMS period of 8 years. The Implementation plan shall include the activities of both the Bidders and the PFCCL/OPTCL, showing all key milestones and clearly identifying the nature of all information and project support expected from the PFCCL/OPTCL. The PFCCL/OPTCL and Bidders together shall finalize the detailed implementation plan following award of the contract.

C.4. Contractor's Responsibilities and Obligations

Contractor's obligations include, but are not limited to, the following:

a. To provide a working system that meets or exceeds the functional and performance requirements of this specification without affecting the operation of the existing systems.
b. To perform equipment engineering and design specific to each location including review of, and conformance with local environmental and earthing considerations.
c. Installation of field devices, hardware, software and communication system.
d. To develop O&M guidelines.
e. Overall integration of equipment/subsystem as defined in this RFP document
f. Integration of new Meters
g. Sharing of relevant interface details at DCU, HES and MDM layers
h. Achieving interoperability for AMI through incorporation of the communication modules (NICs) inside the Smart meters of any make of Smart meters as short listed by OPTCL for this project area in the future.
i. Identifying, buying and maintenance of spares under AMC along with main items to ensure system availability during installation and maintenance period.
j. Project management, project scheduling, including periodic project reports (weekly/monthly basis) documenting progress during the contract period.
k. To provide engineering and technical assistance during the contract warranty and maintenance period.
l. Updation of consumer indexing in the AMI system during the installation and maintenance period
m. To identify all additional Equipment and services necessary to ensure compatibility between new and existing equipment.
n. To implement all minor civil works necessary for installation of proposed equipment and provide the details of such work to the PFCCL/OPTCL.
o. To define source power requirements for each cabinet/ rack of equipment provided and the total power requirements to run the system
p. To ensure that all the required hardware, software, and firmware satisfy the requirements of this specification and are suitable for future scaling, optionally with upgrades.

q. To conduct factory and site acceptance testing of all hardware, software and firmware provided
r. Conduct type tests or provide documented evidence of type testing and BIS certification to the PFCCL/OPTCLas sought in specifications.
s. To provide a Quality Assurance Plan and access to the manufacturing process, as required.
t. Shipment of all equipment to designated locations and/or storing areas.
u. To provide storing, maintenance of storing area and security including full responsibility for protection from theft and fire for all the items to be supplied. The warehouse may be a temporary storage area to be constructed by contractor or the same may be taken on rent in OPTCL premises.
v. Prepare and submit all documentation and drawings in hard copy as well as soft copy.
w. Supply all required spare parts, maintenance aids, and test equipment, software maintenance and testing tools
x. Training of the PFCCL/OPTCLpersonnel.
y. Hardware, software, and firmware maintenance, debugging, and support of the software applications, and maintenance of all supplied equipment.
z. To provide full backup of all installed software applications and data.
aa. To test restoration of the system from the backup provided.
bb. Availability of service, spare and expansion parts for the supplied items for the complete design life i.e. 8 years from the operational acceptance of the system as per details in various parts of this specification.
cc. Auxiliary Power Supply comprising of UPS for 8 hours battery backup along with all necessary distribution.
dd. Assistance in development & implementation of consumer engagement plan

Detailed descriptions of the Contractor's obligations, in relation to individual items and services offered, are delineated in other sections of this specification.

C.5. Exclusion from Contractor's Scope

Following shall be excluded from Contractor's scope:

a. Construction of building for AMI Control Centre
b. Lighting system for AMI Control Centre
c. Interior and IBMS (Integrated Building Management System) of building for AMI Control Centre
d. Air conditioning and ventilation for AMI Control Centre
e. Firefighting system for AMI Control Centre
f. A.C. input power supply for AMI Control Centre

C.6. PFCCL/ OPTCL's Responsibilities and Obligations

The PFCCL in coordination with OPTCL will provide the following items and services as part of this Project:

a. Review and approval of the Contractor's designs, drawings, survey reports and recommendations.
b. Review and approval of test procedures.
c. Participation in and approval of "Type", factory and site acceptance tests.
d. Review and approval of training plans & reading material
e. Providing support and access to facilities at the sites, including consumer premises.
f. Arranging necessary shutdowns and work permits.
g. Implement the major civil works such as expansions or construction of rooms, trenches etc. as required for the equipment to be provided by the Contractor.

h. Provide to the extent possible drawings for AMI Control Centre building where equipment installations are planned.
i. Obtaining requisite statutory clearances and/or approvals as required to be taken by OPTCL for project work.
j. Providing available details of the consumer indexing and informing the contractor of any changes in the area network during the project installation and maintenance period
k. Providing A.C. power supply inputs as defined in this specification
l. Provide equipment storage space
m. All required documents for delivery of material at site
n. Travel expenses of employer's representative during training & testing
o. Regulatory support/changes as required
p. Approvals/Suggestions for change in submitted documents/ reports to be given to contractor in time bound manner.
q. Development & implementation of consumer engagement plan
r. Overall project management
s. Organize project review meetings
t. Releasing funds to contractor as per agreed terms of Payment.

C.7. General Bidding Requirements

The Bidder shall be responsive to the technical requirements as set forth in this specification. The bidder's proposal shall include the compliance for Technical Proposal including the documents listed in the Table below shall be provided in the bid.

S.No.	Description	Enclosure Reference	
1.	Details of the supplied hardware		
2.	System Sizing Requirements Annexure-G	Page no. Ref no.	
3.	Quality Assurance Program (As per Quality Assurance of Technical Specification Volume III)	Page no. Ref no.	
4.	Detailed project implementation plan (As per Technical Specification Volume III).	Page no. Ref no.	
5.	Approach paper for implementation	Page no. Ref no.	
6.	Schematic Diagram of Proposed System Configuration	Page no. Ref no.	
7.	Overall system architecture capable of scaling out	Page no. Ref no.	
8	Table of Compliance (As per Annexure-D)	Page no. Ref no.	

A detailed project implementation plan and schedule that is consistent with the scope of the project and OPTCL'S specified objectives shall be provided. The plan shall include the activities of the Bidders, PFCCL/OPTCL, show all key milestones and clearly identify the nature of all information and project support to be provided by PFCCL/OPTCL.

A commitment and a clearly defined plan to develop a system support organization, based in India and capable of providing a full range of local services (including software and hardware maintenance and upgrade support) for the life of the delivered systems. The bidder may offer the bought-out items from more than one manufacturer.

C.8. Applicable Standards

Specifications and codes shall be the latest version, inclusive of revisions, which are in force at the date of the contract award. Where new specifications, codes and revisions are issued during the period of the contract, the Bidders shall attempt to comply with such, provided that no additional expenses are charged to the Employer without Employer's written consent.

In the event the bidder offers to supply material and/or equipment in compliance to any other international standard other than Standards listed in the document, the Bidders shall include with their proposal, full salient features of the new standard for comparison.

In case values indicated for certain parameters in the specifications are more stringent than those specified by the standards, the specification shall override the standards.

C.9. Technical Obsolescence

The systems which are at a risk of technical obsolescence over the operating life of the system should be identified; this should include end-of-sale and end-of-support policies governing the proposed technologies. Forward and backward compatibility need to be considered and mitigation option shall be indicated in detail and shall not be limited to periodic update from OEM/System supplier

D. STRATEGY FOR IMPLEMENTATION

Strategy for Implementation: Implementation of Smart Grid in Rourkela would result in following benefits:

1. Incremental Revenue on account of reduction in AT&C losses
2. Better Consumer Relationship Management
3. Increased operational efficiency

Constitution of SMART GRID Cell/Group and State Level Program Management Unit (SLPMU): To implement Smart Grid in Rourkela, GRIDCO/ OPTCL/ WESCO will have to constitute the following:
Smart Grid Cell/Group

1. Smart Grid Cell/Group would have to be constituted by WESCO. The role of the group would be from concept to commissioning of the system and would involve co-ordination with various stakeholders, including NSGM, for all issues related to implementation of the project.
2. WESCO will also have to nominate a Nodal Officer for interacting with NSGM.
3. State Level Program Management Unit (SLPMU)
4. As per NSGM Guidelines, OPTCL has to constitute a State Level Program Management Unit (SLPMU) for implementation of Smart Grid. The function of the SLPMU shall be as follows:
   a. To review Smart Grid Project development and implementation.
   b. To interact and report the progress of work to NSGM, MoP, SERC and Govt of Orissa (GoO)
   c. To review and take feedback of Consumer Awareness program.
   d. To review and approve findings of Third Party Independent Evaluation Agency on Base Line Data, Incremental Revenue Data and AT&C Losses figures**.**
5. After constitution of SPMU, OPTCL would have to approach SERC for the following:
   a. To intimate about the Smart Grid Project being implemented in Rourkela and obtain approval of SERC for the proposed Revenue Sharing Model.
   b. To obtain approval for AMI with Auto Disconnect – Connect
   c. To request for Reliability Surcharge
   d. To intimate about increment in Meter Rental as per provisions in current Tariff Notification.
6. Consumer Awareness Program: WESCO would need to have a Consumer Awareness Program through frequent advertisements in Local Newspapers/ Local TV Channels, articles in Newspapers, mentioning the benefits of Smart Grid in their monthly bills being served to the consumers every month. WESCO would have to nominate an official who can be approached by consumers locally to know about Smart Grid as well as hold few Consumer Awareness Campaigns.
7. Funding of Project Cost: NSGM – 30%; OPTCL – Nil; SGIA – 70%

Funding

OPTCL	0%
SGIA	70%

8. Further, WESCO will need to incur cost on the additional infrastructure facilities (however, will not be a part of this DPR proposal) which inter-alia would include the following:
   a. Land, Data Centre & Customer Care Centre & various server rooms and other Civil & Structural Works including earthing.
   b. Infrastructures such as air conditioning system
   c. External & Internal electrification & Lighting,
   d. Firefighting system
   e. Any T&P, testing equipment's. etc.

f. Office furniture, Computer and software for use in office except for the computers required for business process software.
g. Any contract for IT/ Outsourcing of services of revenue expenditure type.
h. Communication equipment's such as mobile phone, telephone etc
i. Manpower for managing collection centers, data center & customer care centers
j. All conductor, Cables and its Erection Procurement and Construction has not been proposed though a data of the same is being furnished to WESCO

D.1. General Scope of work

1. Selected bidder to establish proposed Advanced Metering Infrastructure System in Project Area i.e. operation subdivision no. 5 of OPTCL within 12 months from the award of contract.
2. Selected bidder to provide 12 months "Warranty support" after Go-Live of project area and 36 months "Post implementation support" after the end of warranty period.
3. For the maintenance phase, selected bidder to keep the availability and reliability of the complete AMI system by at-least 99%.
4. For the maintenance phase, selected bidder to dedicatedly post at-least one (01) support engineer (Diploma in Electrical Engineering with at-least 2 years relevant experience) per circle for resolving field related matters and at-least one (01) dedicated Project – In-charge (B. Tech / B. E. in Electrical Engineering with at-least 5 years relevant experience) at the Data Centre for application management and overall system maintenance.
5. Integrating the proposed AMI system with other necessary software being implemented under this project.
6. User Acceptance Testing and Sign-Off from OPTCL would require for declaration of Go-Live. PFCCL will provide necessary support for coordination with OPTCL.
7. Bidders to provide complete year wise plan for post implementation phase with deployment of resources year wise.
8. Proposed AMI Software should be scalable in nature taking into consideration an average growth rate of consumers and associated infrastructure to be 7.5 % per annum for the complete project duration from the date of award of contract to selected bidder. Enterprise- wide license for the software components is a mandatory requisite. Proposed AMI Software and associated equipment's should be capable of handling at-least 50000 connections, without any additional infrastructure and cost implication to OPTCL.
9. The Proposed AMI solution/AMI system should have complete interoperability for accommodating all types of FRTU/MFM and communication H/W and vice-versa should also be there for any future up gradation of hardware / software.
10. Selected bidder to setup a Project Management Office, Rourkela within 30 days from the date of award of contract. This office shall remain operational at least till the successful Go- live and User acceptance of this project. All the dedicated resources are to be deployed in Rourkela for day-to-day coordination with OPTCL.
11. All supplied items must conform to the detailed technical specifications mentioned in this tender document.
12. Packaging and transportation from the manufacturer's work to the site including ports and customs clearance will be borne by the bidder.
13. The equipment shall be highly reliable providing 99% uptime and ensuring availability of the network of 99%
14. Unloading, Receipt, storage, preservation and conservation of equipment at the site.
15. The Bidder in consultation with PFCCL Project In-charge and OPTCL Local In-charge shall determine the exact positioning of equipment Installation, housing of equipment.
16. Insurance of all equipment from manufacturer's site till installation, commissioning, handing over and user acceptance will be borne by the bidder.
17. Maintain the mandatory and recommended (a minimum of 5%) spares during warranty and FMS

period and provide the list of the same.

18. Install the equipment, obtain OPTCL acceptance and submit a copy of the same to designated authority of PFCCL.
19. Post completion of installation and commissioning works, the selected bidder shall provide a complete and final location table and spreadsheet indicating all locations including all the relevant following information.
20. The proposed solution must efficiently enable all required interfaces and integration, including integration with the existing software as detailed in existing IT infrastructure.
21. Provide ongoing product information and documentation such as User manuals, System administrator manuals, Technical manuals, Installation guides etc. as applicable.
22. The Bidder shall be responsible for providing all material, equipment and services specified or otherwise, which are required to fulfil the intent of ensuring operability, maintainability and the reliability of the complete work covered under this specification.
23. It is not the intent to specify all aspects of design and installation of associated systems mentioned herein. The systems, sub-systems and equipment/devices shall conform in all respect to high standards of engineering, design and workmanship, and shall be capable of performing continuous commercial operation.
24. The bidder shall make his own necessary arrangements for the following and for those not listed anywhere else:
    a. Office and store.
    b. Transportation.
    c. Boarding & lodging arrangement for their personnel.
25. The supplier shall submit the data sheets for each of the equipment model detailing the specifications of the equipment.
26. The equipment models shall be supported by the OEM for a minimum period of next five years.
27. Technical Specifications of various type AMI equipment, Hardware & Softwares shall have full compliance with NSGM guidelines and its amendment, which is available on website www.nsgm.gov.in. However, any higher specifications are acceptable in case of any technical specification has become obsolete.
28. Software should provide following unique features:
    a. Collects, archives and analyses collected parameter from all sites.
    b. Can handle thousands of remote sites.
    c. Multiple users are able to view the data in required formats for graphs, trends, tables and reports. This enables better monitoring and control of transformers.
    d. Can be customised based on number of AMI installed and number of user clients.
    e. Each user can be assigned individual passwords and rights.
    f. Graphic user interface.
    g. View location of transformers on map
    h. Real time instantaneous parameters.
    i. Log energy parameters for energy reports.
    j. View all parameters and reports via web clients.
    k. Trends.
    l. Alarms and events
    m. required log sheets
    n. Required reports can be configured by the user.
    o. Send alarm messages via e-mails to pre-defined users in case on events.
    p. Send reports to pre-defined user at set intervals.
    q. Results in saving capital equipment by early detection of expected faults.
    r. Based on alarm messages received from remote DT sites.
    s. Detect location of transformer faults.
    t. Detect energy loss based on energy through DT and actual energy billed.

29. SYSTEM DESIGN AND ENGINEERING

a. The Bidder shall be responsible for detailed design and engineering of overall system, subsystems, elements, system facilities, equipment, services, including systems application software etc.
b. It shall include proper definition and execution of all interfaces with systems, equipment, material and services of Owner for proper and correct design, performance and operation of the project.
c. Bidder shall provide complete engineering data, drawings, reports, manuals and services offered etc. for Owner's review, approval and records

30. SPECIAL TOOLSANDACCESSORIES

i. The bidder's proposal shall include the list of special tools, testing equipments and accessories required during development stage, for day to day operation and maintenance of the system.
ii. The bidder's proposal shall include the list of special tools, testing equipment and accessories required for day to day operation and maintenance of the system. All such tools shall be supplied by the bidder. The bidder should clearly bring out the list of such tools in their technical proposal. However, the prices of these special tools shall be included in the related equipment price in the price template given in this RFP.

31. INSTALLATION&IMPLEMENTATION

i. The bidder shall be responsible for installation of all identified hardware and associated equipments at Data Centre, DR centre, Control Centre, Substations, DT locations, HT and selected LT Consumers and Communication network covered under the specification.
ii. The bidder shall be responsible for provisioning of all required manpower and tools/kits for safe, reliable, proper and correct installation and providing support services for IT infrastructure created for a period of five years.
iii. The successful bidder shall be responsible for installation and configuration of software, hardware and other equipment supplied to the satisfaction of the owner. This shall include but not be limited to: Installation of the software at Data Centre, DR Centre and various other locations, Installation of AMI equipment at Sub stations, DTs, HT and Select LT consumers.
iv. Post Go-Live, the software vendor shall provide support to fix any bug related to implementation. The entire system would be considered as successfully installed when the software will run with actual live data at site for 3 months without any bugs (Bug is lacunae in the system that prevents/ delays an operation or performs a function within the system at suboptimal level/ at performance level lesser than that specified in this specification or provides incorrect operational data or provides incorrect results in any data format in the reports generated by the users).
v. Demonstration of all the features of latest version of software; Acceptance testing of the system thus implemented to the owner's satisfaction.

32. TESTING, COMMISSIONANDSUCCESSFULOPERATION

The scope includes testing and commissioning & implementation of all equipment, sub-systems and systems of the project and putting the min to successful technical & commercial operation. The scope shall include but not limited to the requirements given elsewhere in the specification. The bidder shall be responsible to provide all necessary testing and commissioning personnel, tools/kits, test equipment etc.

33. TESTING ANDACCEPTANCEPROCEDURES

Testing and quality assurance in software development is more rigorous since each component has to be more reliable, if it is to be reused. A system is tested at various stages of development and deployment. For example, each component is tested as a unit for checking the correctness of its own code. Further, the component is tested with its dependent components. After final release of the entire set of components, system is tested for the correctness of system functionality. Finally, the components are further tested in simulated production load for performance and load analysis.

The Smart Grid Implementation Agency shall be responsible for the testing processes such as planning (includes preparing test plans and defining roles and their responsibilities), preparation (consists of preparing test specification, test environment and test data) and execution (includes testing at various levels like unit level, integration level, system level and production).

34. TESTPLAN

Testplansarepreparedforeachphaseoftesting.Theinitialtestplaniscreated during the Project Planning phase. The initial test plan describes who performs which type of testing and when. Ideally master test plan covers all types of test i.e. from unit testing to production testing. The Implementation Agency is expected to submit the test plans to OPTCL for approval. Any changes made to the test plan during the project lifecycle should be communicated to OPTCL for approval.

35. TEST SCENARIOS

The Selected bidder should prepare test scenario for each business scenario. A test scenario when executed should fulfil a business requirement as per the scope of business functionality. Test scenarios include following:

a. Test Specification- During the test specification phase, the test cases are specified. It consists of description of the input, process to be executed and a prediction of output results.
b. Test Environment-Component developer does unit testing and integration testing. Integration testing can be delegated to a specialized testing group. Each of the members in the testing group is provided with testing environment according to his/her role and responsibilities. Following is sample testing environment for testing:
    i. A workstation
    ii. A set of tools and applications required on workstation like access to user interface, browser etc.
    iii. Access to centralized document database (where all the project related documents are maintained)
    iv. Access to testing tools and defect logging tools
    v. Access to the central database or repository for development and unit testing (this database contains sample test data)
    vi. Access to deployed components
c. Test Data - Test data is prepared for testing at each stage. The test data should be prepared in such a way that it covers basic path and every alternate path of the code. The basic path and alternate paths are prioritized to capture relevant data. Tools can also be used to generate test data.

36. Test Execution

The following testing steps are usually employed in the project lifecycle. The Implementation Agency is expected to follow these steps:

a. Unit Testing - In unit testing, each piece of code has to be rigorously tested. At this stage testing is done according to the priority of path of code. All the test results are logged in the defect logging tools. After the completion of testing, code is corrected for defect logs. This process is iterative till criteria for successful testing is reached.

b. Integration Testing - Upon completion of unit testing, integration testing begins. The purpose is to ensure distinct components of the application still work in accordance to customer requirements. Test sets will be developed with the express purpose of exercising the interfaces between the components. This activity is to be carried out by the Test Team. Integration test will be termed complete when actual results and expected results are either in line or differences are explainable/acceptable based on client input.

c. Incremental Integration Testing - Continuous testing of an application as new functionality is added.

d. System Testing - System testing is performed when all the components are delivered to central repository prior to the release of the software. The testing is done on priority basis of business processes. All the defects are logged and assigned to respective component owners. The component and unit testing is performed after the correction of code. However, it may depend on size and type of individual test specifications. Impact analysis is useful to narrow done testing efforts by identifying critical test cases affected due to code change.

e. Pre-Production Testing – Pre-Production testing is done simulating the production load. Test data is either prepared or generated from the tools. This testing is used to evaluate performance, load capacity and concurrency. Load testing tools can also be used for this purpose. Following special types of testing are done during Pre-Production Testing Phase:

    i. RegressionTesting-Theobjectiveofregressiontestingistoensuresoftwareremains intact. A baseline set of data and scripts will be maintained and executed to verify changes introduced during the release have not “un done” any previous code. Expected results from the baseline are compared to results of the software being regression tested. All discrepancies will be highlighted and accounted for, before testing proceeds to the next level.

    ii. Performance Testing-Although performance testing is described as a part of system testing, it can be regarded as a distinct level of testing. Performance testing will verify the load, volume, and response times as defined by requirements.

    iii. Load Testing-Testing an application under heavy loads, such as the testing of a website under a range of loads to determine at what point the systems response time degrades or fails.

    iv. Installation Testing - Testing full, partial, or upgrade install/uninstall processes. The installation test for a release will be conducted with the objective of demonstrating production readiness. This test is conducted after the application has been migrated to the client’s site. It will encompass the inventory of configuration items (performed by the application’s System Administration) and evaluation of data readiness, as well as dynamic tests focused on basic system functionality. When necessary, a sanity test will be performed following the installation testing.

    v. Security/Penetration Testing- Testing how well the system protects against unauthorized internal or external access, wilful damage, etc. This type of testing may require sophisticated testing techniques.

    vi. Recovery/Error Testing – Testing how well a system recovers from crashes, hardware failures, or other catastrophic problems.

f. Acceptance Testing – During the test scenarios definition, for each of the business scenario, an acceptance criterion is defined. Acceptance criteria include expected behaviour of the s/w component and the expected results (data). Expected results form a part of the Exit Criteria. In addition to expected result and behaviours, some conditions are also specified in the exit criteria. They can be:
   i. Number of bugs to be discovered for a functional module. This depends on size of the functionality and is an indicator of amount of testing done.
   ii. If any medium or low-priority errors are outstanding - the implementation risk must be signed off as acceptable by OPTCL and Implementation Partner along with consortium partners
   iii. All High Priority errors from System Test must be fixed and tested

   Implementation Agency needs to get the acceptance criteria approved from OPTCL for all the functional components of the system. The Acceptance Criteria for each release into production environment will be agreed upon by Implementation Agency in consultation with OPTCL prior to release from Testing to production environment. After installation, if any bug is reported or there is non-compliance to requirements then a proper procedure should be followed. End-user should report ("Change Request") to his/her supervisor about the bug that will in turn get forwarded to Project Manager (PM). PM will forward the List of change request to Implementation Partner along with consortium partners. After the bug is fixed, it should be reflected in the production copy after testing it.

g. Performance Testing - The bidder has to test and demonstrate the operational performance requirement as defined in the clause 9 of the specification after completion of entire scope.

   This will be part of acceptance testing. The system will be taken over by owner only after successful operational performance testing. The bidder has to arrange necessary hardware/software to demonstrate the performance testing.

   Bidder should note that PFCCL /OPTCL can appoint a third-party agency for conducting any part of above testing procedures (in addition to the testing carried out by the bidder).

37. INTEGRATIONSCOPE

All required external systems shall be integrated on a continuous basis using an integration middleware layer. The integration is expected to be on on-line real time basis or batch mode where appropriate and shall operate in an automated fashion without manual intervention. The scope of external integration will be, but not limited to:

a. Integration with other Smart Grid Applications, which are being implemented.
b. The integration may use a continuous integration middleware layer as specified by the vendor. This integration middleware layer could then be used to undertake any future integration between applications. The integration middleware shall be based on Service Oriented Architecture (SOA) and shall use publish / subscribe mechanism. Purchaser does not want to build and maintain point to point integration.
c. The integration middleware shall be open architecture based.
d. Data to be integrated must be validated by the developed interfaces.
e. The data to be integrated will be mapped, transformed (if required) and reconciled automatically.
f. All interfaces are to be self-checking so that any exceptions or data validation errors are reported by the system. In addition, integration logs should be maintained that confirm the success or otherwise of the interface, complete with control totals.
g. The mapping should be manageable through a GUI based administrative interface

D.2. Training for the employees -

The vendor shall be required to organize following training for the owner's personnel. The bidder shall provide training to various user groups as nominated by OPTCL ,WESCO, PFCCL .The bidder shall provide the Training Approach in the response. The training modules shall include but not limited to –

a. AMI Administration & Configuration
b. AMI/AMI Installation and Trouble-Shooting
c. Application Management
d. Application Data Analysis

Training arrangements–All trainings must be of minimum 1 day or bidder can propose more no. of days training along with batch size as per requirement. A training calendar with contents and sessions will be also agreed upon between bidder and PFCCL /OPTCL. The selected bidder shall be required to organize following training for the OPTCL/ PFCCL personnel:-

Professional Training- This is the training for the core Group of implementation team of the OPTCL and PFCCL. This team will comprise of members from all the Business Functions and IT sections. Each member would be trained in the relevant function/module. This Training would be required to be given to approximately 20-25 personnel. It is the responsibility of implementation agency to deliver this training. Standard curriculum designed and agreed by the owner for hardware, software and network preferably from the OEM partner or OEM's certified training partner shall be arranged for each group. The vendor is required to quote on per person basis for this training. The Purchaser will prefer if a portion of the training is conducted on-site.

End User Training-The bidder will provide training to the owner's team on a "Train the Trainer" basis. The Owner's team so trained will then train all of the owner's end users. It is estimated that this training will require around 8 groups, with each group comprising of around 12 to 15 persons. These training sessions will be required to be conducted at any of the sites.

The recommended training material can be in paper/ electronic media with courses on BPA software fundamentals, business process overview, job activity training, and delivery options being on-line, CBTs, instructor led class rooms, etc.
During the course of the implementation, the bidder is expected to complete /be involved in the following activities in terms of skill transfer:

a. Testing scripts should be prepared to test the business processes and scenarios of the new system.
b. The project team members will further develop these testing scripts into training documents.
c. Training material will be organized by functional process that will serve as the training documentation for a particular functional area.
d. Assist the Owner's team members in creating procedure documents for use in conjunction with the other training material. A procedure document will list all of the transactions necessary to complete a business scenario whereas a training document lists the steps to execute a transaction. Each step will be a transaction referenced in a training document.
e. Procedures will be listed for all the online steps needed to complete a scenario.
f. In addition to functional training document binders and procedures, the project team members will create training courses and exercises. The training courses will contain all the

training documents and necessary to train an end-user in his / her role. The training exercises will list common business scenarios and input data that the user will enter to practice with the newly developed BPA software.

g. Vendor will assist in administering training to project team members and / or power users, to “train the trainers”.
h. Vendor should assist in administering training to the rest of the users / peers in functional areas based on the course documentation developed by the project team and vendor.

The training will consist of a curriculum of courses to address the issues of system operation, business-wide application, changed business processes and general use of the new system.

Representatives from the successful vendor, Purchaser’s implementation project and change management teams will be involved throughout in the development of training strategy, training material design and development, standards and training delivery to ensure that change management issues are incorporated, and that training strategies and materials are aligned to the requirements of the project and as business-specific as possible.

The roll out of the training program will be coordinated with the overall project implementation strategy.

39. SUPPLYOF MEDIA -
The successful bidder shall supply two copies of media of AMI applications and its related software’s solution against the specifications.

D.3. Documentation Scope –

The following documents (one set each)will be required for smooth functioning of the system. The successful vendor will provide ongoing product information for referential purposes and facilitating self-education by OPTCL/PFCCL personnel. Key aspects shall include: What documentation is included in the standard license fee, for example:

a. User Manuals
b. System Administrator Manuals
c. Technical Manuals
d. Installation Guides
e. Business Process Guides
f. Program Flow Descriptions
g. Sample Reports
h. Screen Formats
i. Toolkit Guides
j. Troubleshooting Guides
k. Frequently Asked Question (FAQ)Guides

The clarity, comprehensiveness and accuracy of the documentation (an example document should be made available):

a. The media upon which documentation is made available.
b. The frequency of documentation updates and distribution mechanism of the updates.
c. The ability for documentation to be customized for or by PFCCL /OPTCL

Hard copy and soft copy of user manuals are expected to be provided by the successful vendor. These should include information on the application concepts in addition to transaction and field

level documentation. Additionally, the Technical Users Information manual provides information on the BPA software's table structures.

Selected Bidder will be expected to assist in developing operational procedure manuals. If the user manuals are provided in Word format, the client should have the ability to customize their own manual to include specific business processes or operational procedures.

Selected Bidder can also be required to provide context sensitive on-line help, which includes all materials provided in the hard copy manuals. Where possible, users should be able to add their own on-line help documentation.

D.4 Timelines for Delivery and Implementation

The bidder is expected to complete the Enterprise Wide-implementation of AMI system on all connectionswithin12 months from the date of award of contract by the PFCCL.
Bidder shall submit a detail Gantt chart along with the following implementation schedule. Bidders shall drill down these activities into sub/sub-activity in the chart. The chart shall also detail out time and resource effort required to execute each activity. The detailed bar charts for all the work activity shall however ,be discussed and agreed to by the successful Bidder with the owner before start of the execution of work. However , provided that the detailed bar chart shall not fall short of the scope of work provided under the NIT and in the event of agreed scope of work is reduced by virtue of the bar chart, the same is subject to written approval of PFCCL and will attract proportionate reduction in total cost along with other charges.

Table 43Timelinesfor Delivery& Implementation

Sr. No	Activity Name	Start Date	Weekly Plan						EndDate
			W1	W2	W3	W4	W5	.....	
1	Resource Mobilization and establishment of Site office								
2	System Design and approval from Owner								
3	Proof of concept of the Overall Solution								
4	Establishment of AMI System								
5	Roll Out in Project Area								
6	Warranty Services (12 months)								
7	FMS Services (Y1-Y8)								

The detailed BOQ is given in Annexure E. The Bidder has to carry out the detailed survey and collect the required data. All other associated works/items described in the Technical Specifications for a viable and fully functional system is the responsibility of Bidders.

The contractor shall have to maintain the system for Eight (8) years after operational acceptance by <OPTCL>. During the seven years of maintenance, Contractor shall maintain system availability as mentioned in this document. Contractor shall also maintain necessary spares such as smart meters, routers, etc. to attend problems during maintenance of the system. During maintenance period, contractor shall maintain the service level as explained in this Technical Specifications.

The Contractor shall also bear the cost of recurring charges for GPRS/3G/4G, static ISP connection and any license fee for operating RF in licensed frequency band till completion of maintenance period.

Comprehensive warranty should be provided for the system, by the contractor(s), for one (1) year after operational acceptance by <OPTCL>.

Scope also includes

1) Consumer Indexing
2) Capturing the baseline parameters/KPIs that are proposed for improvement (as defined in section 3.7.11)
3) Develop an overall AMI Architecture capable of upgrades and scaling out as per future requirements.
4) Installation of additional equipments to account for area load growth during maintenance period as defined in Volume 1 section 5.10 of this RFP
5) System Security and access with due consideration of data privacy, confidentiality cyber security guidelines.
6) Preparation of an approach paper describing overall architecture and operational philosophy of the proposed AMI solution and methodology for achieving different functionalities, specified in this document and also highlight additional features, if any

This RFP is being floated by **PFCCL** on behalf of **<OPTCL>** to appoint a contractor for Supply, Implementation Testing, Commissioning & Maintenance of AMI system at **<OPTCL>**.

D.5. Exclusion from Scope of Work

Further, WESCO will need to incur cost on the additional infrastructure facilities (however, will not be a part of this DPR proposal) which inter-alia would include the following:

k. Land, Data Centre & Customer Care Centre & various server rooms and other Civil & Structural Works including earthing.
l. Infrastructures such as air conditioning system
m. External & Internal electrification & Lighting,
n. Firefighting system
o. Any T&P, testing equipment's. etc.
p. Office furniture, Computer and software for use in office except for the computers required for business process software.
q. Any contract for IT/ Outsourcing of services of revenue expenditure type.
r. Communication equipment's such as mobile phone, telephone etc
s. Manpower for managing collection centers, data center & customer care centers
t. All conductor, Cables and its Erection Procurement and Construction has not been proposed though a data of the same is being furnished to WESCO
u. DG sets to run the data centre
v. Water leakage detection system
w. UPS for servers to run the data centre
x. CCTV camera and recording infrastructure
y. Access control
z. Single sign on server/ LDAP server

E. ADVANCED METERING INFRASTRUCTURE (AMI)

1. Advanced Metering Infrastructure (AMI) is a system that measures, collects, transfers and analyses energy usage and communicates with metering devices either on requestor on a schedule basis. This system includes Smart meters, communication systems, data concentrator units, customer associated systems, Meter Data Acquisition System (MDAS), Meter Data Management (MDM)software, and business analytics.

2. AMI shall be installed in Rourkela Smart City to improve visualization of energy consumption & power quality at consumer level and facilitate peak load management

3. AMI enables two-way communications hence has the potential to communicate from the OPTCL to the meter and vice-versa. OPTCL can have online consumption record of each individual in fifteen (15) minutes time block which will be helpful in analyzing consumption pattern & forecasting energy usage. At the same time consumer can access online data for their consumption, which would help them in controlling monthly bills.

4. Automatic meter recording would mitigate requirement of manual process of meter reading, which would make billing system more accurate efficient and fast. Using two-way communication system pricing signals may also be sent to consumer participating in demand response mechanism. With the available data received in advanced metering infrastructure, OPTCL has following tools to make systems mart:
   a. Energy audits can be done at distribution transformer level to check theft
   b. Load pattern of individual consumer can be observed
   c. Withdrawal of power above sanctioned load may be checked
   d. Tampering may be checked in near real time
   e. Control actions from control center for load curtailment may be taken Remote connection/ disconnection is possible
   f. Sending alert to consumer for higher load withdrawal, bill non- payment etc. is possible
   g. For variable pricing, signal transmission is possible

5. WESCO is implementing various IT related initiatives like New Billing system, ERP etc. Since these applications are also required for Smart Grid project, hence integration is proposed. OMS will also be required to be integrated with SCADA system, whose costing has been taken in the proposal.

6. Under advanced metering infrastructure, smart meters shall be installed for all domestic, commercial, industrial, HT, street lights and other consumers as identified by WESCO. Meter Data Management System (MDMS) along with necessary hardware/ software shall be installed at control center.

7. Billing data of Smart meters installed in Smart Grid shall be pushed to billing application being installed by WESCO.

8. GIS mapping and consumer indexing data shall be integrated with advanced metering infrastructure applications and periodic synchronization/ updation shall be carried out.

9. AMI Objective: Remote meter reading for error free data, network problem identification, load profiling for better load management, signal for partial load curtailment in place of load shedding, remote connect/ disconnect/ reconnect and energy audit. The system will also allow to test and evaluate technology, meter functionality, communications capabilities, error free

data for billing and billing system integration, engineering performance, computer systems and software needed to manage and maintain meter network and supply.

10. The major components of AMI infrastructure would include the following:
    a. Smart Meters
    b. RF DCU (Data Concentrator Unit) along with Canopy or Access Point
    c. Head End System (HES): This is a critical interface to the field devices which enables a 2-way communication system to support polling meters for data collection, send remote firmware upgrades/ programmable parameter inputs to meters, managing load curtailment, connect/ disconnect and pricing signals as generated from the MDMS/ other applications interfaced to the smart meter. HES shall support PUSH and PULL communication architecture. This will interface with the Meter Data Management System (MDMS) over web services and the data exchange models.
    d. Billing parameters based on TOU but ready to manage future dynamic tariffs
    e. Energy Accounting
    f. Load profile research
    g. Post Paid/ Pre-Paid Metering
    h. Reports
    i. Network and communications
    j. Web application with updated on-line data of consumers (consumer data shall be integrated <into <OPTCL's> existing consumer portal> or <to a new delivered portal if the OPTCL so desires>) etc.
    k. Network Management System
    l. Mobile app: Bidder shall provide a mobile app through which consumer shall be able to log in through android/iOS/Window based mobile app to see information related to his/her energy consumption. App shall also provide platform for implementation of peak load management functionality by providing existing tariff & incentives rates, participation options etc. Features in this app which relates to demand response should be treated as provisions for future integration. This mobile app shall be part of complete system and therefore no additional cost shall be payable for upgradation / maintenance separately.

11. The AMI system shall help OPTCL to manage their resource and business process efficiently. AMI system shall support the following minimum functionalities:
    a. Remote Meter data reading at configurable intervals(push/pull)
    b. Time of day (TOD)/TOU metering
    c. Pre-paid functionality
    d. Net Metering/Billing
    e. Alarm/Event detection, notification and reporting
    f. Remote Load Limiter and connection/ disconnection at defined/on demand conditions
    g. Remote firmware upgrade
    h. Integration with other existing legacy systems as defined in this document
    i. Import of legacy data from existing modules/ MDAS where ever possible. The extent and modalities of integration with the existing legacy system has to be worked out by the bidder.
    j. Security features to prevent unauthorized access to the AMI including Smart meter & meter data etc. and to ensure authentication of all AMI elements by third party.

    The System should accurately maintain system time synchronization across all devices to ensure accuracy of data. <The system should support the interfacing with the future Smart Grid functionalities like peak load management, distribution automation including self-healing

system, distributed energy resources etc.> The communication network shall preferably be able to support multiple applications.

The Bidder shall submit an approach paper describing overall architecture and operational philosophy of the proposed AMI solution and methodology for achieving different functionalities, specified in this document and also highlight additional features, if any.

12. AMI is being proposed with Sub Ghz RF Communication network as per the following:
    a. Smart Meters & Router/ Access Point/ DCU shall be RF Mesh
    b. Router/ Access Point /DCU communication with the Smart Meter shall be Sub Ghz RF
    c. Router/ Access Point/ DCU to HES shall be communicated through MPLS/ Ethernet/ GPRS as per requirement.
    d. In control center, Meter Data Acquisition System & Meter Data Management Software shall be hoisted which will collect, store and analyze data received from DCU/ Meters.
    e. Control Centre shall be in Rourkela and DRC in Bhubaneswar/ Burla.

13. Head End System shall be the core application for interface to field devices. It shall perform the following functions:
    a. Acquisition of meter data
    b. Two way communication with meter, including load control
    c. Sending remote firmware upgrades/ programmable parameters to meters/ DCU
    d. Sending load control signals to meters
    e. Maintaining time sync with DCU / meters
    f. Sending Connect/ Disconnect signals to the Smart Meter.
    g. Control signals, event messages etc. shall be handled on priority.
    h. Reporting communication history for meters and DCU
    i. Supporting encryption of data transmission for secure communication

14. Meter Data Management system shall take information from MDAS for further analysis. It shall have following functions:
    a. Asset Management
    b. AMI Installation Support
    c. Meter Data Analysis
    d. Exception Management
    e. Service Orders Generation
    f. Customer Service Support
    g. Reporting
    h. Revenue Protection Support
    i. User Friendly Interface
    j. Integration with other Systems
    k. Pre-Paid Metering

15. Implementation of above infrastructure shall provide an excellent tool to OPTCL for operation of efficient, accurate, intelligent and customer friendly metering system.

16. In this regard, a detailed survey was undertaken as per the following:
    a. All Consumers under Rourkela Smart City Area have been mapped on a DGPS Map
    b. A detailed Feeder wise/ DT Wise/ Pole Wise consumer indexing has been done
    c. Duplicate Connections/ Data, Ghost Consumers etc have been removed.

E.1. SCOPE OF WORK

Scope of Smart Grid Implementing Agency (SGIA) - The scope and various components of the proposed Smart Grid project are as follows:

For the deployment of smart metering in Rourkela, OPTCL is in the process of building a RF communication network covering approx. 82,000 Smart meters. The scope of work includes:

E.1.1. Design, supply, installation, testing, commissioning and FMS of Smart Meters, AMI system& RF Mesh with a network platform that can support multiple applications like AMI, Net metering over a single communications platform.

E.1.2. Selected bidder will propose & establish the solution for approx. 82,000 consumers but it should be scalable to cover the entire OPTCL consumers.

E.1.3. Site survey for identification of network design (equipment locations etc.) and detailing out comprehensive bill of material.

E.1.4. Development of communication interface module for other field equipment's including Smart meter data flows from Meter Endpoints to HES to MDMS as per frequency defined in SLA.

E.1.5. Supply, installation and commissioning of MDMS suitable for OPTCL and its integration with existing IT system.

E.1.6. Installation, commission and integration of RF Network, Meters and MDMS for smooth functioning of AMI.

E.1.7. Training to OPTCL staff and associated documentation for all deployed systems to ensure a smooth transition from deployment to post-deployment operations and maintenance of the system. Scope also includes training to OPTCL's staff and associated documentation for all hardware / software updates as and when required.

E.1.8. The bidder must also specify the degree of redundancy kept while designing the system for self-healing features to be effectively working and the performance parameters those that capture this commitment consistently. 99% of Communication NIC cards in the network should be accessible from HES at any point of time. Bidder should design the system accordingly.

E.1.9. The bidder shall confirm that, the HES has sufficient logic driven smoothening built in features, for example: reliably determining current status of a meter once an outage alert is received from the meter, as well as, ability to suppress or filter false positives from outage and restoration notifications. There should be provision for deploying more such user defined logics.

E.1.10. The bidder shall confirm that, the bandwidth made available by the Ministry of communications for this purpose, shall not in any way limit or hamper the performance of both the AMI & other applications running concurrently on the same communication canopy as well as supporting other Smart grid applications.

E.1.11. Bidder to submit it's after sale service support plan and escalation matrix in order to meet contractual obligations and performance guidelines. Preferably, bidder should have service office in Rourkela, once PO is awarded. The bidder should have minimum 5 technical persons on roll of the company having relevant experience. CV of employees to be submitted along with the bid.

E.1.12. It would be the responsibility of the bidder to integrate their NIC module with various (any 2 meters complying IS16444) meter OEM's. Necessary agreement must be executed at their end as per requirement. In future, it would be bidders' responsibility to integrate new meter or other application/equipment operating on IEC104 / modus as decided by OPTCL, in RF canopy network.

E.1.13. Bidder to also indicate timeframe for developing solution with meter and other application equipment's/OEM's.

E.1.14. The bidder shall confirm that offered RF canopy solution and associated network elements including NIC should be tuneable over unlicensed sub GHz frequency range.

E.1.15. Interoperability for AMI shall be achieved through incorporation of the communication modules (NICs) of the technology service provider inside the Smart meters of various makes of Smart meters, short listed for this purpose as of now & in future also for next 15 years.

E.1.16. **The bidder shall ensure the possibility of up-gradation of the Firmware / software in the** communication modules/devices from remote from time to time to meet the increasing demand of the system in operation/overcoming system limitations/bugs. The bidder shall also ensure incorporation of new hardware (communication devices, meter, NIC etc.), if required, in future. The bidder therefore shall ensure that all such upgrades shall seamlessly fit into the existing end to end systemin operation and shall be backwardly compatible to the earlier generation devices/software/Firm ware in operation to guard against obsolescence at no cost to OPTCL.

E.1.17. **The bidder shall spell out the time duration required and associated success rate in case of** OTA firm-ware up-gradation on number of meters/communication devices simultaneously, well in advance, from the design stage and shall also ensure that all these Access points & Nodes to be used in the system shall have more than adequate memory capacity for the Firmware upgrades to happen smoothly, and securely, meeting the possible changing enhanced expectations of the next 15years,as well as, avoiding overwriting operations during the Firmware upgrades, thus avoiding obsolescence of the hardware installed at site in quick time.

E.1.18. The network canopy shall be designed in such a way that it can accept improvements based on the experience / performance / new expectations/need from time to time.

E.1.19. Bidder to commit that the communication media is transparent and shall be exclusively used for data transfer of OPTCL and that capacity can be allocated such that it will not be used for any other purpose without any consent from OPTCL. Bidder shall submit corporate principal certificate for adherence of this clause.

E.1.20. **The bidder shall guarantee for providing service & expansion support in the aforesaid area** (at least for backward compatibility) for at least15 years.

E.1.21. Bidder must submit a certificate on company letterhead, stating that the bidder hasn't been blacklisted by any institution/ organization/ society/ company of the Central / State Government ministry/department, or its public sector organizations during the last five years, with company stamp and signed by authorized signatory.

E.1.22. The offered solution including (H/w, s/w, OS, licenses & others) shall have life cycle of 5 years from post go Live.

E.1.23. Specifications of hardware shall be provided along with bid and Manufactures authorization for warranty shall be in Name of OPTCL.

E.1.24. RF network provider shall guarantee minimum signal strength without discrimination of Network topologies in licensed area.

E.1.25. Bidder shall provide 3rd party security audit certification after go-live.

E.1.26. Bidder shall replace upgrade or replace third party equipment free of cost in case the support on said equipment is withdrawn by respective OEM during this period i.e. declared as End of support by OEM.

E.1.27. Vendors to submit its experience / credentials for integrating its solutions with multiple applications used in power distribution OPTCL nationally / internationally for solution scalability, ease of integration point of view.

E.1.28. For product Maturity, Vendor to submit performance certificates from customers (power distribution OPTCL national / international) along with their contact details for their experience on the solution implemented in their OPTCL – OPTCL should be free to get in touch with them for clarifications, if needed.

E.1.29. Offered solution to comply with the existing IS standards for applications as mentioned in RFP & its Feasibility to change/modify the offered solution based on changes happened in standards in future.

E.1.30. Proven solution/reference Worldwide – Bidder to submit supporting documents reference where bidder equipment is installed, commissioned and running successfully, OPTCL reserves the right to visit the site to ascertain bidder's capabilities. Bidder shall facilitate such visits at the client site. Travelling and lodging, boarding cost will be borne by OPTCL however all local travel expenses, relevant permissions shall be arranged by the bidder. An undertaking to the same along with proposed client sites for visit needs to be submitted in this regard.

E.1.31. OPTCL reserve the right to review integration mechanism along with prices of NIC card with Smartmetersafterevery2years.

E.1.32. The NIC card /communication module ceiling price shall be revised after every 2 years period subject to market price. The NIC card /communication module price will be mutually decided between meter OEM and bidder subject to ceiling price offered to OPTCL by the bidder.

E.1.33. Submission of Documents: In addition to the document as required in QR section following additional documents are to be submitted along with the offer by the bidder(s):

a. Network design report of proposed solution for entire geographical area of OPTCL with tentative placement of offered network elements
b. Detailed specification & Guaranteed Technical Particulars of devices/hardware to be used
c. All necessary test Certificates &licenses wherever applicable
d. Point by point clarification of the RFP
e. GTP & deviation sheet

E.1.34. Total devices required for roll out after complete RF Engineering

a. The "Written Undertaking" document
b. The Technical deliverable document
c. Declaration by the bidder as per this document
d. The detailed Commercial offer in tabular form encompassing various options, covering all possible items (in a separate sealed envelope)
e. Suggested SLA documents
f. Security write-up
g. All Type Test certificates & clearances from Legal/Regulatory bodies

E.1.35. There are other administrative expectations such as maintenance of local warehouse(s) at Rourkela for storage of communication devices, checking by OPTCL & subsequent distribution to end users. Factory Acceptance Tests shall be carried out on features & functionalities as decided by OPTCL from time to time and the communication devices shall be accepted if it remains within the acceptance criteria. Depending upon deployment terms and other conditions, pertaining to handling & delivery, shall be detailed and discussed subsequently with the selected bidders before commercial bidding process for final roll out.

E.1.36. Maintenance of the Network during Rollout

a. All network communications equipment shall support local (on-site) and remote (system headend) non-intrusive diagnostics capable of detecting any abnormal operating parameters including, but not limited to, network communications, memory failure, powersupplydegradation,microprocessorfailures(e.g.ComputerOperating Properly watch dog events),firmware/software problems, excessive device temperature, SNR degradation etc.
b. Transition period for end Point will be considered as 1-month post installation.
c. It will be the responsibility of bidder to maintain SLA after 1 month of installation of any end point. However, during this transition period, the bidder should ensure monthly billable read to ensure that communication of end point is well established using the offered solution.

d. Transition period will be considered as 3 days post installation of other network elements except smart meters. On expiry of transition period for network elements SLA will be applicable.
e. Roll out period will be considered from date of deployment of the network to deceleration of post go- live.

E.1.37. It shall be the responsibility of solution provider to resolve any communication and IT

E.1.38. Failure Rate: Less than 0.75% failure rate per annum for all network communications equipment over the required operating life (i.e. 7 years) of the system. (Failure is defined as any occurrence when the equipment is not functioning per design specification).

E.1.39. Less than 3% failure rate per annum for all network communications equipment over the extended operating life of the system. (Operating life and extended life of the equipment is typically defined by contract between the OPTCL and the communication equipment supplier.

E.1.40. The network solution provider shall ensure that applicable network security methodologies and controls are exercised fully and not diluted at any point of time.

E.1.41. The network solution provider shall ensure two-way communication success rate, for both AMI & operational applications and response time within 6 seconds for operations and switching of electrical devices with a success rate of 99%-, consistently.

E.1.42. The network solution provider shall ensure Turn-around-time (TAT) for response in the following manner under service disruption.

a. Over and above the criterion mentioned in this document, OPTCL reserves the right for prioritisation of any issue at any point of time.
b. The bidder shall submit a report on the network status on daily, weekly and monthly basis, even when the system is not covered under FMS, so that; proactive responses may be generated for the betterment of the system.
c. Penalties shall be there when the performance of the system shall be below the threshold parameter, as mutually agreed and documented, which will be judged on the availability of AMI&DA data availability over a period.

E.1.43. Applicable Standards, Frequency and Statutory Approvals

a. The system and all individual equipment must comply with all relevant statutory requirements and regulations that are set by government authorities, such as the Wireless Planning & Coordination (WPC) Wing of the Ministry of Communications and Information Technology. Wireless technologies need to comply with the Indian statutory bodies that govern communication related aspects such as WPC (Wireless Planning Co-ordination wing) which oversees licensing and management of all wireless spectrums in India. Equipment Type Approval (ETA) is to be obtained for communication modules as per Department of Telecom, Government of India requirements. Radio emission characteristics for the chosen band shall comply with latest NFAP and the G.S.R (General Statutory Rules) notifications from Department of Telecom, Government of India.
b. All documents demonstrating compliance, approval and usability must be submitted by the bidder along with the technical proposal after award of contract. Failure to do so may result in bid disqualification. Any statutory clearances related to installation will be in OPTCL's scope but has to be facilitated by the bidder.
c. The RF Mesh Communication Devices shall comply to the following standards: IEEE802.15.4 – IEEE standard for Information Technology – Telecommunications and Information Exchange between Systems – Local and Metropolitan Area Networks – Specific Requirements Part 15.4: Wireless Medium Access Control (MAC) and Physical layer (PHY); IEEE 802.15.4g – IEEE Standard for Smart OPTCL Networks or any other equivalent standard /alliance.
d. The bidder to submit relevant certification in order to validate the conformance and interoperability of their IEEE 802.15.4 an IEEE 802.15.4g or equivalent implementations.
e. If the proposed solution operates in licensed frequency band, bidder to attain the

required license on behalf of OPTCL for entire geographical area of OPTCL for 15 years. Cost of procuring license and license fee for next 15 years will be in the scope of bidder.

E.2. AMI FUNCTIONAL REQUIREMENT

The main objective of AMI is to enable two-way communication between smart energy meter and Head End System (HES) to enable remote reading, monitoring & control of electrical energy meters (consumer, feeder, DT meters etc.) to serve as repository of record for all raw, validated and edited data. The sanitized data may be subscribed by other OPTCL function for higher order analysis and billing and collection engine etc.

The AMI system shall help OPTCL to manage their resource and business process efficiently. AMI system shall support the following minimum functionalities:

(i) Remote Meter data reading at configurable intervals(push/pull)
(ii) Time of day (TOD)/TOU metering
(iii) Pre-paid functionality
(iv) Net Metering/Billing
(v) Alarm/Event detection, notification and reporting
(vi) Remote Load Limiter and connection/ disconnection at defined/on demand conditions
(vii) Remote firmware upgrade
(viii) Integration with other existing legacy systems as defined in this document
(ix) Import of legacy data from existing modules/ MDAS where ever possible. The extent and modalities of integration with the existing legacy system has to be worked out by the bidder.
(x) Security features to prevent unauthorized access to the AMI including Smart meter & meter data etc. and to ensure authentication of all AMI elements by third party.
(xi) Facility for the utility to communicate price signals to AMI meters.

The System should accurately maintain system time synchronization across all devices to ensure accuracy of data. <The system should support the interfacing with the future Smart Grid functionalities like peak load management, distribution automation including self-healing system, , distributed energy resources etc.>The communication network shall preferably be able to support multiple applications.

The Bidder shall submit an approach paper describing overall architecture and operational philosophy of the proposed AMI solution and methodology for achieving different functionalities, specified in this document and also highlight additional features, if any.

E.2.1. General AMI System Requirement

Smart Meter (Single phase whole current, Three phase whole current, CT & PT operated three phase meters and CT operated three phase meters) for consumers/ system shall be provided based on Radio Frequency (RF) mesh in Licensed frequency band as permitted by WPC or in Unlicensed frequency band/ Power Line Carrier Communication (PLCC) or GPRS/3G/4G communication technology or combination of these technologies as per the site requirement and to ensure the performance level given in this document. The smart meter data using RF mesh/PLCC shall be collected by Data Concentrator Units (DCUs)/Access point and transported to HES through WAN while the data from smart meters using GPRS/3G/4G technology shall be transported directly to HES through WAN. The contractor shall ensure proper data exchange among Smart meter, DCU, MDM, HES and other operational/requisite software as part of fully functional AMI system.

Contractor shall adhere with the appropriate security algorithm for encryption and decryption. For smooth functioning of the entire system, it is essential that the details of such algorithm including the mechanism of security key generation be kept in a secured escrow account which shall be used by the OPTCL only in case of termination of the contract for reasons whatsoever.

Contractor may design appropriate architecture for providing end to end metering solution. Contractor is free to decide upon the best solution out of all the available options. However, the entire responsibility of fully functional AMI system shall rest with the contractor in order to meet the performance levels as given in this document. The communication provider may adopt Radio Frequency (RF) mesh in licensed frequency band as permitted by WPC or in Unlicensed frequency band/ Power Line Carrier Communication (PLCC) or GPRS/3G/4G communication technology or RF based canopy system or a combination of these technologies as per the site requirement adopting best available technology in the proposed area of implementation.

E.2.2. Smart Meters

Single Phase & Three Phase whole current smart meters shall comply with IS 16444 (latest version). Three Phase CT operated meter shall comply IS 16444: Part 2. The contractor has to furnish valid BIS certification before supply of meters.

After meter installation, customer identification no., meter ID, its hardware & software configuration, name plate details, make, type i.e. 1 Phase or 3 Phase shall be updated in DCU/HES/MDM. The information would also be updated on the portal/app for providing information to consumers.

The Basic Features of Smart Meter shall be:

a. Measurement of electrical energy parameters
b. Bidirectional Communication
c. Integrated Load limiting switch
d. Tamper event detection, recording and reporting
e. Power event alarms such as loss of supply, low/high voltage, out of band frequency
f. Remote firmware upgrade
g. Time of Use (ToU) tariff
h. Net metering features (for smart meters with Net-metering feature)
i. On demand reading

E.2.2.1. Whole Current A.C. Single Phase Two Wire Smart Energy Meter Of Accuracy Class 1.0 <with/ net-metering>

Smart Meter shall be an A.C. static-watt hour meter of accuracy class 1 for the measurement of alternating current electrical active energy of frequency 50 Hz, with time of use registers, internal connect and disconnect switches with two way communication capability. The bi- directional communication module can either be of built in type or plug-in type with suitable sealing arrangement. <The meters with net-metering facility shall measure flow of both forward (import) and reverse (export) energies.>

The single phase whole current Smart Meter shall conform to the standards and specification as specified in Annexure A

E.2.2.2. Whole Current A.C. Three Phase Four Wire Smart Energy Meter Of Accuracy Class 1.0 <with/ without net-metering>

Smart Meter shall be an A.C. static-watt hour meter of accuracy class 1 for the measurement of alternating current electrical active energy of frequency 50 Hz, with time of use registers, internal

connect and disconnect switches with two way communication capability. The bi- directional communication module can either be of built in type or plug-in type with suitable sealing arrangement. <The meters with net-metering facility shall measure flow of both forward (import) and reverse (export) energies.>

The three phase whole current Smart Meter shall conform to the standards and specification as specified in Annexure B.

E.2.2.3. Three phase CT operated alternating current smart meter Of Accuracy Class 0.5S

Three phase CT operated alternating current smart meter shall be four wire smart energy meter of accuracy class 0.5S with two way communication facility. The bi-directional communication module can either be of built in type or plug-in type with suitable sealing arrangement. <The meters with net-metering facility shall measure flow of both forward (import) and reverse (export) energies.>

The three phase CT operated Smart Meter shall conform to the standards and specification as specified in Annexure C

E.2.2.4. Tests

E.2.2.4.1. Type tests and test certificates

Single phase and three phase whole current Smart meter shall be type tested for all the type tests as per IS: 16444 (latest version) and three phase CT operated Smart Meter hall be type tested for all the type tests as per IS: 16444 Part-2 (latest version) in a government approved laboratory. The number of sampling for testing of meters and criteria for conformity would be as per IS 16444 and IS 16444 Part-2. The supplier shall have to submit all type test certificates along with the bid.

Type test should not be older than 3 years. Without the above type test certificate the offer shall not be considered. Employer reserves right to select randomly one meter from the offered lots for inspection for its type test and if meter during type test is found failed then either the order placed shall be cancelled with the Contractor to collect all the meters at its cost for the supplied meters or Contractor shall have to replace all supplied meters at their cost after manufactured and successful type test within time frame given by the PFCCL.

E.2.2.4.2. Routine and Acceptance Test

The Factory Acceptance and Routine tests shall be carried out as per IS 16444 and IS 16444 Part-2. Apart from above test, meter shall be also be tested for all functional requirement through communication as part of acceptance test

E.2.2.5. General and Constructional Requirements for Meters

a. Meter shall be BIS marked as per IS 16444/ / IS 16444 Part-2.
b. General & construction requirement shall be as per IS 16444/ IS 13779/ IS 16444 Part-2
c. <In Home Display (IHD) shall be optional and the specifications of the same would be as per agreement between the bidder and the OPTCL>

E.2.2.5.1. Meter Base and Cover

Meter base & cover shall be as per IS 16444/ IS 13779/ IS 16444 Part-2. The meter Base & cover shall be break to open design. The material for meter base and cover shall be made of high grade polycarbonate

E.2.2.5.2. Terminal Block and Cover

As per IS 16444/IS 13779/ IS 16444 Part-2

E.2.2.5.3. Design

Voltage circuit, sealing arrangement, terminal block, terminal cover and nameplate 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.

E.2.2.5.4. Circuitry

As per IS 16444/ IS 16444 Part-2. The contractor shall submit the details of source/agencies from whom purchase of various components of meters have been made by them by them to the employer

E.2.2.5.5. 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 <OPTCL>, purchase order no. & year/month of manufacturing shall either be punched or marked indelibly. The rating plate information shall be as per relevant IS.

E.2.2.5.6. Connection Diagram

As per IS 16444/ IS 16444 Part-2

E.2.2.5.7. Fixing Arrangement

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.

E.2.2.5.8. 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 OPTCL>

E.2.2.5.9. Meter Box

The Meter Box would be provided as per <requirement of the OPTCL>.

E.2.2.5.10. 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.

E.2.2.5.11. 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.

E.2.2.5.12. Testing and Manufacturing Facilities

The manufacturer shall have NABL accredited laboratory to ensure accurate testing calibration as per IS 16444/ IS 13779/ 16444 Part-2 for acceptance test.

E.2.2.5.13. Inspection

a. 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 <OPTCL> may be sent in a pack for provision by OPTCL/WESCO after completion of test by the OPTCL/WESCO& after receipt of the meter.
b. PFCCL/OPTCL may select the meter randomly as per sampling plan for acceptance test as per IS 16444/ IS 16444 Part-2. The meters shall be tested for all functional requirements as part of acceptance test as per IS 16444/ IS 16444 Part-2. After testing, these sample meters shall be additionally sealed by the inspecting officer and one copy of the inspection report will be handed over to the manufacturer.

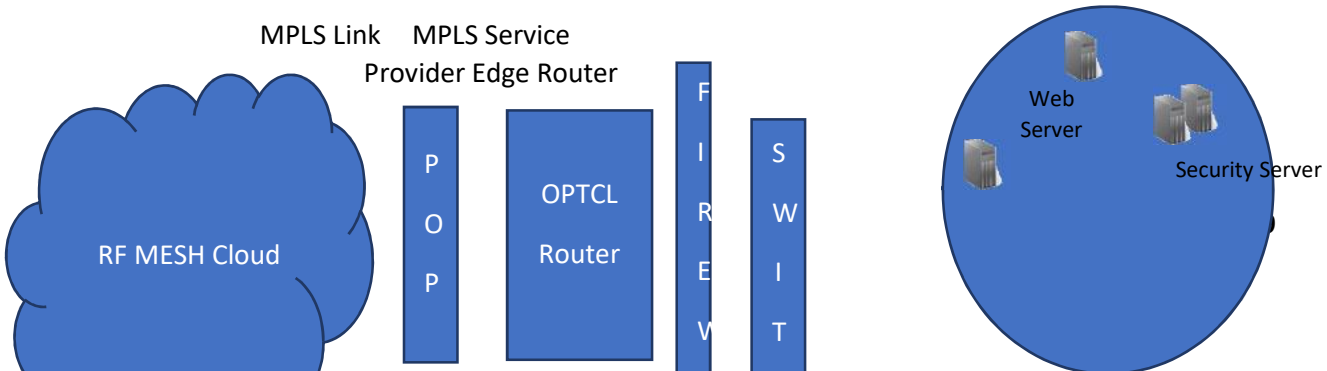
E.2.3. Communication Canopy

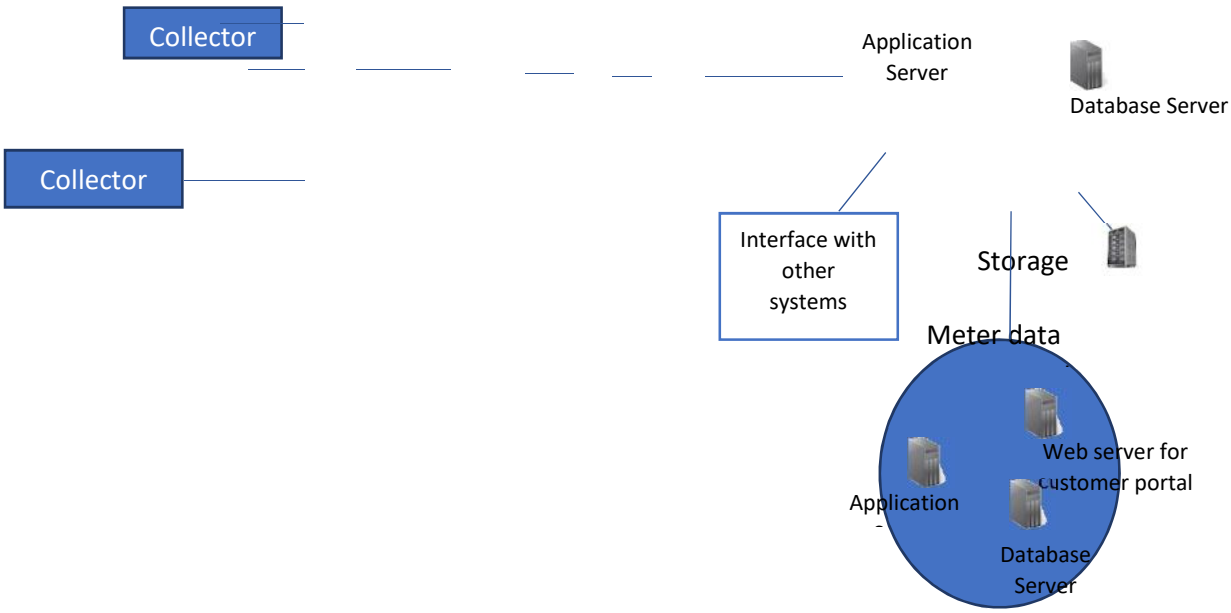
OPTCL intends to setup a communication canopy over any of the unlicensed frequencies in India (865-867 MHz/2.4GHz/5.8GHzetc.) or licensed wireless band, spread across its total pilot project area of 32sq.km,for AMI applications. RF canopy network should be designed to cater data requirements of 2,00,000Smart meters. RF canopy should bedesignedtooperateatminimum50% of designed capacity (peak data requirement with guaranteed performance)for full scale deployment and balance capacity shall cater to performance expectations during difficult & challenging times and also for meeting future applications.

The communication infrastructure should either be based on RF mesh network / PLC or cellular network or a combination of these. The communication network shall be based on suitable standards from ITU/IEC/IEEE/CEN/ CENELEC/ ETSI for NAN and WAN network. Communication network shall provide reliable medium for two-way communication between various nodes (smart meter) & HES. RF based network should use Licensed frequency band as permitted by WPC or Unlicensed frequency band. The engagement of network service provider would be in the scope of Contractor to meet the performance level as given in the document.

OPTCL envisions that the last mile communication infrastructure thus created shall be scalable over the air for supporting more end-point deployments and other applications in future. The system shall become fully operational in the next 1.5 years and shall consequently not be affected by obsolescence.

PictorialrepresentationofproposedconnectivitybetweenendpointdevicesandControlCentersis as shown below Figure





The RF canopy thus established, using wireless technology, shall be in the form of a RF mesh with field devices like nodes, routers/repeaters, collectors/gateways etc. and Meters forming the mesh & operating in a licensed/unlicensed frequency band. For solution on licensed band, frequency license should be approved by Ministry of IT & Communications, Govt. of India for use in Power OPTCL. These devices shall facilitate a network infrastructure which can be distributed over a large span of distance covering the entire licensed area of OPTCL.

The Collector/Gateway/Repeaters/Extender Bridge units are to be installed at a suitable maintainable height primarily on OPTCL owned properties so as to have a maximum coverage area. Bidder may also envisage to utilize mobile towers of service providers for installation of network elements at bidders' cost. In case bidder use 3rd party mobile towers for creating RF canopy, bidder is required to submit documentary proof for back to back arrangement with tower owner for entire duration of project i.e. 15 years. The communication network shall be reliable, scalable and shall have facility for auto registration and self-healing. Tripartite agreement will be executed between OPTCL, bidder and ISP as per the guidelines of TRAI (if required)

It should be fault tolerant & "sleepy" in nature to optimize on resources. Suitable network management system(NMS) shall also to be provided to monitor the performance of the communication canopy round the clock from the Control Centre of OPTCL. The NMS shall provide view of all the networking elements deployed at site and enable configuration, parameterization of the networking devices and the nodes over the air. The communication network may also have to support other communication technologies (Ethernet/cellular) for specific need based isolated deployment and if so, this shall have to be integrated into the same HES for ease of operation . Bidder to share capability of the offered solution and components including future product roadmap (support for Ethernet and cellular).

OPTCL will provide the necessary latitude & longitude of all the relevant substations/ assets, OPTCL establishments and other information as decided to facilitate bidder. However, it will be the responsibility of bidder to make necessary site visits & ensure that proposed solution will work as per SLA terms mentioned above.

For any further details regarding location of end points, bidder may do site visits under intimation to OPTCL office.

Bidder to submit pointwise detailed description of questionnaire on Approach and methodology to be followed for developing RF canopy after award of work before commencement of work and approval:

S.No	Question	Bidder Response
1	Please describe RF communications canopy architecture for the proposed applications mentioned in the scope of RFP, starting from the head end system and ending with the different end point. If licensed frequencies are used, please include details for the acquisition of these frequencies and any support provided. Please include standards used in this communication architecture.	
2	Please provide information on the RF and EMF emissions and the impact of the AMI technology on the public. Has your company participated in any studies or conducted studies related to this impact? How have customer issues been resolved? Include any white papers or studies as an attachment.	
3	Please provide communications deployment guidelines for the proposed system based on specific system restrictions, requirements, and limitations. Also provide guidelines for number and location of collector and/or repeater devices.	
4	If the proposed AMI communications is an RF mesh technology, please describe the overall mesh recommended operating parameters including any limitations on the number of hops for network efficiency. If other RF technology, please describe the limitations and recommendations to obtain optimum network coverage and capacity.	
5	If the system is deployed according to recommendations for collector locations, optimum hops, optimum poll rates, etc., what is the expected data throughput of the deployed network? Throughput claimed should be demonstrated at field /FAT. What is the impact of changes in the network topology on the data throughput? NOTE: Data throughput is the amount of data that can be transmitted through the network accounting for collisions, overhead and data retries.	
6	Please describe the expected operational capabilities and limitations that would exist a single/ multiple network element becomes non-operational for any extended period of time. What data collection limitations would exist? What are the capabilities and limitations to recover data from the meters associated with such failure?	
7	Bidder has to study the requirement for RF mesh, design, supply, erection & commissioning of all the equipment's & auxiliaries for deployment of RF mesh. Describe how the OPTCL ensures that the number and location of the network equipment is sufficient to meet the performance and coverage requirements and additional equipment will not be required to achieve the required level of performance.	
8	All ongoing support & maintenance activities required for the communication infrastructure equipment such as batteries, comm. card, etc. will be covered in FMS.	
9	The timing required to complete a disconnect or reconnect operation for the proposed applications mentioned in the scope of RFP should be as per SLA. Does this include a confirmation of successful disconnect or reconnect? Is a separate request to the end point required to validate successful disconnect and reconnect?	

S.No	Question	Bidder Response
10	If the system is deployed according to recommendations (network elements installed according to network plan) and the system is collecting daily data according to recommended poll rates, how much of the total bandwidth is available for other operations? At what bandwidth utilization does the network cease to be functional?	
11	Does the communications technology support prioritization, such as control commands will be transmitted with a higher priority than read requests? If so, please describe.	
12	Describe what tools, reports and capabilities are included in the head end software to support the management and troubleshooting of the communications infrastructure? Provide samples where possible.	
13	Describe the roles and skill sets required for the maintenance of the communications infrastructure	
14	Do you provide software and hardware tools for the field technicians to support the troubleshooting and testing of the communications equipment and the communications network? Please describe all tools (hardware and software) available for the testing, verification, configuration and evaluation of RF canopy. Do you provide required software & hardware tools for field technicians to read data from meters/ routers & also controlling of meters (sending reconnection/disconnection command) from field using portable devices?	
15	Is there any current or pending litigation with respect to the proposed communication technology? This litigation could be with respect to ownership rights to the technology or with respect to alleged harmful effects of the technology. Please describe in detail any such litigations and the impact to OPTCL. Bidder to provide a certificate stating that no litigation is pending.	
16	Describe the upgrade and maintenance process and capabilities for the communications network. How is firmware updated in the communication network equipment? Can components of the network equipment be upgraded in the field? What is the bidder policy when components in the network are no longer available?	
17	Are there any alternative tools for communication with the end points and network elements (other than through the installed RF canopy)? Is there a tool for collecting information from one or end points & network elements, for scenarios where the network is unavailable or non-operational? Please describe	
18	Describe prioritization mechanism of data flow for different applications	
19	Are meters permanently connected to the communications medium or is a connection established on an 'as required' basis? If the meters are not permanently connected what mechanisms are used to initiate communications? Please describe.	
20	How many concurrent meter – Head-End communications sessions can be supported at any one time. What is typical data rate in kbps for a meter to Head-End communications? Please describe	

S.No	Question	Bidder Response
21	The Bidder shall provide a listing of all known sources of interference to the proposed technology solution such as cellular systems, wide-area data networks, distribution automation systems, power line carrier systems, etc.	
22	Please describe Interference Management: The system shall not cause any harmful interference to other systems. The bidder shall resolve any impact with other parties as needed.	
23	Radiation Exposure: The AMI supplier shall ensure that their devices and installations are within the acceptable human exposure limits per international standards/WPC norms and as required for the OPTCL service territory. Please describe.	
24	Embedded firmware and software shall be configurable and upgradeable locally and remotely & notification should be sent to HES as well as local device. Please describe.	
25	The equipment should be certified by international accreditation bodies. Relevant certificates need to be provided.	
26	Data Storage and Extraction: a. All network communications equipment shall utilize non-volatile memory for storing and retaining data. Data storage shall be sufficient to provide redundancy for one full billing cycle i.e. 30 days for all meters under this device. b. All network communications equipment shall provide a means for extracting stored data directly from the device in the event of network communications or equipment failure. (Using local device Firewall protected RF/ RS 232/ Ethernet)	
27	Network Equipment Battery Replacement: If it is necessary to replace network equipment batteries within the required operating and extended operating life of the system, the battery shall have a life expectancy of at least 10 years. The AMI supplier shall provide detailed estimates of the number of estimated replacements along with diagnostics and battery replacement instructions and estimated labour and equipment costs (time and materials) required to perform these replacements. Replacement of any battery will be under FMS.	
28	Installation of meters will not be in scope of bidder. However, discovery and any other troubleshooting for communication to the extent of replacing of NIC card in field will be in the scope of bidder.	
29	Bidder to provide detailed project execution plan within two weeks award of PO for RF mesh, design, supply, erection & commissioning of all the equipment's & auxiliaries for deployment of RF mesh.	
30	Bidder to provide the details of the conditions in which smart meter cannot be a part of RF mesh.	
31	Bidder to share the drawings of mounting arrangements of network elements and should get it approved from OPTCL after award of PO. Bidder should also supply the As-Built Drawings of network once erection phase is over.	

S.No	Question	Bidder Response
32	Bidder are encouraged to review the OPTCL network area through Google map for understanding of RF network layout however OPTCL shall share list of administrative offices, premises wherein data collector can be installed based on Bidder network plan.	
33	RF network creation is sole responsibility of bidder thus any addition of new equipment's like repeaters, Head end, DCU, RF routers shall be inclusive part of Network designing & deployment to meet the performance criteria.	
34	Due to development of any external infrastructure which may hamper the performance of RF shall be relocated and deployed without cost implication during FMS and warranty.	

E.2.3.1. General Requirements

The bidder shall design reliable, interference free & robust communication network. It shall be flexible in terms of providing communication in variable terrain & urban density.

The bidder shall design the network architecture keeping in view the existing and planned infrastructure of the OPTCL. During designing, suitable consideration shall be kept for future expansion as per requirement of OPTCL. Before designing the communication network, the bidder shall do the site survey and would provide the most efficient communication infrastructure.

The entire infrastructure & associated civil works required for installation & commissioning of equipment/devices like DCUs, repeaters, routers & access points etc. shall be in the scope of bidder. The operational testing of all the network elements has to be demonstrated by the bidder to the satisfaction of the OPTCL.

The network solution offered by the bidder should have disaster recovery mechanism in place. The redundancy mechanism of HES and MDM and their disaster recovery plan shall also be described by the Bidder.

The quality of installation of the various equipment & power supply wiring to all field equipment shall be as per standards/ regulations/prevailing practices of the OPTCL. The supply of electricity needed for operation and maintenance of entire AMI system shall be the provided by the Utility free of cost.

A suitable network management system (NMS) shall be provided to monitor the performance of the communication network round the clock. The NMS shall provide viewing of all the networking elements deployed at site and enable configuration & parameterization of the networking devices and the nodes.

E.2.3.2. Network Security

The Network shall have adequate cyber security measures not limited to the measures as described below. The network security would be extended to all the interfaces also.

a. **Secure Access Controls**: The system shall include mechanisms for defining and controlling user access to the operating system environment and applications. Best practices from enterprise security including password strength, password aging, password history, reuse prevention etc. must be followed for access control.
b. **Authorization Controls**: A least-privilege concept such that users are only allowed to use or access functions for which they have been given authorization shall be available.

c. **Logging**: Logs must be maintained for all attempts to log on (both successful and unsuccessful), any privilege change requests (both successful and unsuccessful), user actions affecting security (such as password changes), attempts to perform actions not authorized by the authorization controls, all configuration changes etc. Additionally, the access to such logs must be controlled in accordance to the least-privilege concept mentioned above, so that entries may not be deleted, accidentally or maliciously.
d. **Hardening**: All unnecessary packages must be removed and/or disabled from the system. Additionally, all unused operating system services and unused networking ports must be disabled or blocked. Only secure maintenance access shall be permitted and all known insecure protocols shall be disabled.
e. **Malicious Software Prevention**: Implementation of anti-virus software and other malicious software prevention tools shall be supported for all applications, servers, data bases etc.
f. **Network Security**: The network architecture of the HES must be secure with support for firewalls and encryption. The system shall also allow host-based firewalls to be configured, as an additional layer of security if the network firewall were to fail.

E.2.3.3. Communication Network Elements

E.2.3.3.1. Data Concentrator Unit (DCU) based Communication Network

The Data Concentrator Unit is a gateway for communication of data between the Smart Meters and the HES. The Data Concentrator Unit receives information from the Smart Meter on a scheduled / need basis and stores the data, which can be accessed by HES for onward transfer to MDM.

The DCU provides the central link between Smart Meters and HES, enabling continuous/periodic meter read and control. DCU shall exchange data from smart meters on RF / PLC communication and with HES on WAN.

E.2.3.3.2. Hardware & Power Supply of DCU

a. Enclosure/box of DCU shall be minimum IP66 or better compliant. A suitable mounting arrangement required for DCU installation shall also be provided.
b. A suitable and optimum power supply shall be provided keeping in view that even in case of outage in one or two phases, DCU can be powered. DCU should be capable of withstanding surges & voltage spikes of 6KV as per IEC 61000-4-5 standards. Power supply shall be terminated on suitable sized MCB to facilitate isolation during on-site maintenance.
c. DCU shall have battery with backup for 5 hour for normal meter reading, to push tamper event, carry out on demand reading and the network health status/ connectivity continuity & check. DCU should have the suitable feature to send power outage and restoration message to the HES. The battery shall have a guaranteed life of 5 years.
d. DCU shall have built in Real Time Clock (RTC) with separate battery backup. The battery shall have a guaranteed life of 5 years. It shall have self- diagnostic feature for RTC, memory, battery, communication module, etc. Alternatively, Software driven RTC may also be used as per agreement between supplier and OPTCL.

E.2.3.3.3. Configuration, Functionality & Interface of DCU

a. DCU shall have following configuration functionalities:
b. It shall be able to configure the communication with underlying nodes/meters.
c. It shall pull data from the field devices and push the data at configured intervals to the HES. It should also support the HES in pulling data from the field devises/meters. The data acquisition (Push/Pull) frequency shall be programmable. DCU shall be capable to prioritize control commands.
d. DCU shall ensure a secure communication to HES and shall have internal memory for storing interval data for at least 5 days.

e. DCU shall support on demand read and ping of individual/group of meters.
f. It shall support IPv4 and IPv6 network addressing.
g. DCU shall push events like tamper, power off etc. to HES immediately on occurrence/receipt from field devices/meters.
h. The equipment shall be weatherproof, dustproof and constructed for outdoor installation on poles (minimum rating: IP-55). A suitable mounting provision shall be made for the equipment.
i. Enclosure: Provision for security sealing shall be provided and in case the gasket of the cover is used for protection against moisture, dust and insects, the gasket shall be made of weather and aging resistant material.
j. The list of standards followed in all the devices/equipment used in communication network shall be furnished

E.2.3.3.4.DCU Communication

a. The communication architecture shall be any, as defined under IS 16444.
b. The DCU shall ensure the appropriate backhaul for secure transfer of data to HES either via GPRS 3G/4G or Fiber Optic communication. In case of GPRS/3G/4G backhaul, it shall support SIM card with dynamic IP from any service provider. It shall have Wide Area Network (WAN) connectivity to the HES through suitable means.
c. DCU shall be able to communicate with meters either on RF mesh (Unlicensed or Licensed frequency band as permitted by WPC) or PLC.
d. DCU shall periodically monitor meter reads/downstream commands and shall retry and reconnect in case of failed events/reads.
e. It shall push events like tamper, power off etc. to HES immediately on occurrence/receipt from field devices/meters. DCU shall be able to acquire and send data to HES for full capacity (as per designed for no. of meters/field devices) to ensure the performance level. Full capacity of DCU is required to be indicated in the offer.
f. After Power Interruption, on restoration of power supply, DCU shall establish communication with underlying devices as well as upstream application automatically.
g. DCU shall be able to communicate with the nearest meters depending on topographical features. For further communication among the meters, distance of the other meters with the DCU shall not be a constraint as communication of the nearest meters shall be established with other meters through appropriate mesh formation / other formation.
h. Remote Firmware Upgrade: The DCU shall support remote firmware upgrades as well as remote configuration from the control center. Configuration of programmable parameters of smart meters shall be done through HES.
i. All meters falling under one DCU shall be commissioned and checked for proper communication in presence of OPTCL in-charge.
j. DCU shall keep the records of minimum of the following events:
    i. No of packet failures
    ii. Retry attempts
    iii. Missed periodic readings
    iv. Failure to connect
    v. Tamper events

E.2.3.3.5.Testing of the DCU /Access Point

DCU/Access Point shall be tested for the following:

a. Radio interference measurement (CIS PR 22)
b. Surge test (IEC 610004-5)
c. Fast transient burst test (IEC 61000-4-4)
d. Test of immunity to electrostatic discharges (IEC 61000-4-2)

e. Test of immunity to electromagnetic HF field (IEC 61000-4-3)
f. Resistance to heat and fire

The bidder shall provide IP-55 compliance test certificate for DUC/Access Point.

E.2.3.3.6.RF Mesh Network

In this type of communication network, different nodes (smart meters) shall interconnect with each other using RF mesh network and they shall communicate with nearby routers to transfer the data to access points. In such communication network, if any routers/repeaters/access points fail, then nodes connected on that device shall automatically reconfigure the mesh with available nearby nodes.

E.2.3.3.6.1. General Requirement of Router based RF Mesh Network:

The general requirements for the Router based RF network are specified below:

a. The communication network shall have dynamic & self-healing capability. If one of the communication element like router or access point fails then nodes connecting to that element shall switch to best available element for communication of data to HES.
b. It shall support IPv4 and IPv6 network addressing.
c. Each node shall keep a track of best available nearby nodes.
d. The communication network equipment shall use Unlicensed or Licensed frequency band as permitted by WPC.
e. All the communication network equipment shall be certified by WPC, Government of India for operation in license free frequency band.
f. Suitable network management system (NMS) shall be available to monitor the performance of the communication network round the clock. The NMS shall provide viewing of all the networking elements deployed at site and enable configuration, parameterization of the networking devices and the nodes.
g. It shall support remote firmware upgrading
h. It shall be secure enough to avoid all cyber threats like DDoS, spoofing, malwares etc.
i. The communication network shall ensure secure communication of data to HES.
j. The equipment shall be weatherproof, dustproof and constructed for outdoor installation on poles (minimum rating: IP-55). A suitable mounting provision shall be made for the equipment.
k. Enclosure: Provision for security sealing shall be provided and in case the gasket of the cover is used for protection against moisture, dust and insects, the gasket shall be made of weather and aging resistant material.
l. The list of standards followed in all the devices/equipment used in communication network shall be furnished.
m. Routers / Access Points shall have suitable power supply arrangements. Provision of battery backup for at least 5 hour shall be there to continue operation in case of power supply failure. The life expectancy of battery shall be 5 years or more.

E.2.3.3.6.2. Configuration, Functionality & Interface

Access points shall have following configuration functionalities:

a. It shall be able to configure the communication with underlying nodes/end points.
b. It shall support on demand read and ping of individual/group of meters.
c. It shall push events like tamper, power off etc. to HES immediately on occurrence/receipt from field devices/meters.
d. It shall have Wide Area Network (WAN) connectivity to the HES through suitable means.
e. It shall communicate with routers/nodes/end points on RF mesh (Unlicensed or Licensed frequency band as permitted by WPC).

f. It shall periodically monitor meter reads/downstream commands and shall retry and reconnect in case of failed events/reads.
g. After power Interruption, on restoration of power supply, it shall establish communication with underlying devices as well as upstream application (HES) automatically.
h. Access point shall facilitate recording of:
    i. No of packet failures
    ii. Retry attempts
    iii. Missed periodic reading
    iv. Failure to connect
    v. Tamper events
i. It shall be capable to handle interval data of suitable nos. of any type of smart meter (1ph/3ph). Access point shall be able to acquire and send data to HES for full capacity (No. of meters/field devices it is designed for) within a suitable time period to achieve the performance level. Full capacity of access point is required to be indicated in the offer.
j. Access point shall support remote firmware upgrades as well as remote configuration from the control center.

E.2.4. Head End System (HES)

The main objective of HES is to acquire meter data automatically avoiding any human intervention and monitor parameters acquired from meters.

The bidder shall provide the HES suitable to support the collection and storage of data as per performance level for a defined no. of smart meters with facility of future expansion as per the requirement specified in this document.

HES would perform all the requisite functions as per the defined functionalities of AMI and it is the responsibility of the bidder to supply the requisite software and hardware to achieve the defined functionalities of AMI. HES shall ensure data integrity checks, for example, checksum, time check, pulse, overflow, etc. on all metered data.

HES shall be developed on open platform based on distributed architecture for scalability without degradation of the performance using additional hardware. HES shall support storage of raw meter data, alarms and alerts for minimum 3 days. Adequate data base and security features for storage of data at HES need to be ensured.

The suggested functions of HES (not exhaustive) may be:

a. Acquisition of meter data on demand & at user selectable periodicity
b. Two way communication with meter/ DCU
c. Signals for connect & disconnect of switches present in end points like meter
d. Audit trail and Event & Alarm Logging
e. Encryption of data for secure communication
f. Maintain time sync with DCU / meter
g. Store raw data for defined duration (minimum 3 days)
h. Handling of Control signals / event messages on priority
i. Setting of Smart meter configurable parameters
j. Communication device status and history
k. Network information in case more than one technology is deployed in field between the two devices
l. Critical and non-critical reporting functionality. The suggestive critical events may be:
    i. Alarms and event log for meter events like tamper/power failures etc.

ii. Data not received from DCU/Meter
iii. Relay not operating for connect / disconnect
iv. Communication link failure with DCU/Meter
v. Network failure, etc.

While non critical events may be:

i. Retry attempts on communication failure
ii. Periodic reading missing
iii. Failure to connect etc.

E.2.4.1. Configuration

HES shall facilitate programming of following meter parameters:

a. Load profile capture period
b. Demand integration period
c. Setting of parameters for time of day (TOD/TOU) billing
d. Prepaid function
e. Net metering
f. Billing date
g. Clock setting/time synchronizations
h. Load curtailment limit
i. Event setting for connect/disconnect
j. Number of auto reconnection attempt
k. Time interval between auto reconnection attempt
l. Lock out period for relay
m. Remote firmware upgrade
n. Password setting
o. Push schedule
p. Setting threshold limits for monitored parameters
q. Provision for adding more programming features in future
r. (The bidder may suggest more parameters as per the requirement)

E.2.4.2. Communication

a. HES shall communicate with DCUs/access points using WAN technology
b. HES shall be able to accept data according to IS 15959 part-I/part-II
c. HES shall automatically retry for missed data; the number of retry attempts shall be configurable
d. To receive confirmation on successful execution of a command
e. HES shall ensure data integrity checks, for example, checksum, time check, pulse, overflow, etc. on all metered data

E.2.4.3. Monitoring and Reporting Capability

HES shall have critical and non-critical reporting functionality. The critical & non critical information generated from this reporting functionality shall be made available to MDM at user configurable periodicity.

E.2.4.4. **Critical Reporting**

a. HES shall have alarms and event log for node's (meter) events (tamper/power failures etc.)
b. If data not received from nodes/end points
c. If relay does not operate for connect / disconnect
d. Communication link failure with nodes/end points
e. Network Failure

E.2.4.5. Non-Critical Reporting

HES shall report and keep record of following communication failure events:

a. Retry attempts
b. Missed periodic reading
c. Failure to connect

HES shall support reporting of communication failure history of nodes/routers/access points etc. and give an exception report for nodes/routers/access points not communicating for last 0 – 24 hours (the reporting period shall be on user configurable period). HES shall have feature to send email/SMS notification of configured alarms & events to selected users.

E.2.4.6. Integration

HES shall export all meter data (as per IS 15959) to MDM via CIM/XML. In addition, it should conform to IEC 61968-9 as well as MultiSpeak v3.0 standards to interface with pre-existing MDM solution. In case, OPTCL has implemented any SOA/ ESB architecture, the data exchange to and from HES shall be through this ESB.

E.2.5. Meter Data Management System (MDMS)

The Meter Data Management System shall support storage, archiving, retrieval & analysis of meter data and various other MIS along with validation & verification algorithms. It shall act as a central data repository with interactive dashboard. MDM shall have capability to import raw or validated data in defined formats and export the processed and validated data to various other systems sources and services in the agreed format. It shall provide validated data for upstream systems such as billing, analytics, reporting, etc.
MDM should also support the future requirement of OPTCL and should support the integration of other smart grid functionalities like consumer Information system, customer care, Network planning & analysis, load analysis/forecasting, Peak Load Management, Outage management, Distribution Transformer Health Monitoring system, self-healing system etc. as and when implemented by <OPTCL/WESCO>.

The contractor shall specify and deliver an initial system that supports the collection and storage of data for meeting the performance level for <X no of consumers/ smart meters > with facility of future expansion.

The MDM shall have the ability to selectively choose which data to be maintained and which to be purged or archived <as per requirement of <OPTCL/WESCO> (user selectable)>

E.2.5.1. Asset Management

a. The MDM shall maintain information and relationships between the current installed meter location (apartment, shop, industry/ address etc.), Consumer information (Name etc.), Consumer account no, Meter ID, Type of Meter (type of consumer, 1 phase/ 3phase, with or without relay, etc.), Meter configuration (Demand integration period, Load profile capture period etc.), GIS supplied information (longitude, latitude, connection with feeder/ transformer/ pole etc.) etc.
b. The software should support tracking the status of meters and communication equipment from the date when they are installed in the field. The history of in-service asset location is maintained throughout the device life with start and end dates associated with each in-service location reference.
c. Ability to report and log any damage / deterioration in the meter attributable to consumer /OPTCL.

E.2.5.2. AMI Installation Support

a. The MDM shall also support device lifecycle management from device registration, installation, provisioning, operations and maintenance to decommissioning etc. The MDM shall generate exceptions for meter or modules not delivering the correct meter data after installation.
b. The MDM shall provide a reconciliation report that identifies the meters that have been installed but not communicating for a designated (configurable) period. MDM shall generate reports on the number of meters installed in comparison to the number of meters successfully communicating.

E.2.5.3. Meter Data

a. The MDM shall accept input, process, store, and analyze Meter data from HES and meter data collected through hand held meter reading instruments and manual meter reads. In case of manual reads, provision should be there to insert associated notes like assessed energy, etc.
b. The MDM should accept input, process, store, and analyze non-billing meter data such voltage and power quality data (like under/over voltage, out of band frequency, etc.) as they are available from AMI Head End Systems. The MDM should also support schedule and on-demand meter reads and pinging of meter energized states by authorized users and by other OPTCL systems.
c. The MDM shall provide storage of all collected Meter Data, events and alarm. It shall have capacity of storing 5 years data or more via archiving.
d. The archiving of data should be done at a frequency of x and all data older than x days/hours should be archived. Bidder's solution should describe the process of archiving and restoration from the archive.
e. Correctly track & resolve energy usage across meter changes with no loss of individual meter data.
f. Provide complete history and audit trail for all data collected from meters including commands sent to meters and other devices for 30 days (configurable period).
g. Execute on-demand read processes.
h. Handle special metering configurations like net metering/pre-paid metering/multiple meters at same premises.
i. The MDM shall have the ability to manage at a minimum 15 minute interval data.
j. The contractor shall ensure data integrity checks on all metered data received from data collection systems.

E.2.5.4. Data Validation, Estimation, and Editing (VEE)

a. The validation and estimation of metered data shall be based on standard estimation methods (Like max/avg. of past three days, max/avg. of past X number of similar week days, max/avg. of similar blocks of past X numbers of similar week days etc.). The MDM should also support and maintain following data-
    i. Registered Read Data including register reads, daily billing cycle, as well as derived billing determinants like TOU
    ii. Interval Data channels with variable intervals and variable units of measure
    iii. Calculated Data that is derived or computed such as billing determinants and aggregated loads.
    iv. Event data storage of all collected event and alarm data from meters, network equipment, and MDMS itself
b. MDM shall flag, alarm and trigger an estimating process including but not limited to when the following anomalies occur in the cumulative ("CUM") register reads
    i. CUM Decrements within a billing cycle (except net-metering)
    ii. CUM reads increments more than configurable threshold

iii. Future or old read dates
iv. Number of digits exceeds number of meter dials

c. MDM shall detect, flag, alarm and trigger an estimating process including but not limited to when the following anomalies occur in Time of Use (TOU) register reads
   i. Register Decrements (except net-metering)
   ii. Resets (to zero) (except net-metering)
   iii. CUM reads increments more than configurable threshold
   iv. Future or old read dates
   v. Erratic compared to CUM read (sum of TOU reads minus CUM read)
d. MDM shall detect, flag, alarm and trigger an estimating process including but not limited to when the following anomalies occur in Demand register reads
   i. Do not reset on cycle
   ii. Do not reset coincident with customer move-out or move-in
   iii. Reset off cycle inappropriately
   iv. Too high
e. All data shall be transferred to billing system after meter data validation and estimation including transformer / feeder station wise energy audit.
f. MDM shall estimate usage for non-metered service points such as street lights, farm lights, traffic signals, etc.
g. The MDM shall maintain both the original received raw data in a non- manipulated state, in addition to VEE data.
h. Notwithstanding the latency of data collection via the AMI system, once the MDM receives meter read data, the VEE process occurs in real-time and the post-VEE data is then immediately available to user or external systems.
i. The MDM shall be able to automatically flag data changes from manual edits, VEE (Validating, Editing and Estimating) rules and data source corrections and electronically generate audit trail with timestamps and user-ids.

E.2.5.5. Billing Determinants Calculations

The MDM-

a. Shall allow configuring multiple TOU/TOD options (e.g. the number and duration of TOU rate periods) by customer type, tariffs and day type (weekend, weekdays, and holidays) and by season.
b. Shall support the processing of interval data into billing determinants to include the following at a minimum:
   i. Total Consumption
   ii. Consumption in different time blocks for ToU billing
   iii. Maximum Demand (in kW and kVA)
   iv. Number of tamper counts
   v. Average power factor
c. Shall process interval data and frame it into the appropriate TOU periods for consumption and demand; for example, roll up 15/30minute data intervals into hourly data.
d. Shall have the ability to properly account for special metering situations such as check metering, sub metering, prepaid metering and net metering when calculating billing determinants and sending them to billing and other systems.
e. Shall have the ability to properly account for special situations including, but not limited to, curtailment requests, demand response scenarios when calculating billing determinants and sending them to billing software.

E.2.5.6. Exception Management

a. Ability to capture and log data exceptions, problems and failures and to generate management reports, provide trend analysis, automate generation of service requests and track corrective actions.
b. Ability to group, prioritize, filter and send system generated alarms and events to predetermined email addresses, cellular text messages to phone numbers/SMS/customer care etc.
c. Exception Generation - MDM shall generate exceptions based on configurable business rules including but not limited to the following:
d. Meter tamper alerts
e. Communication module health alerts for Meter/DCU
f. If the consumption is less/more than pre-defined average consumption
g. Negative Consumption (not for net-metering)
h. Power outage indications received from the Smart meter

E.2.5.7. Service Orders

a. The MDM shall generate service orders based on configurable rules for various events and alarms such as stop meter, tampers, problem in communication networks, etc.
b. MDM shall send service orders via SMS, email, etc. with the email addresses / phone numbers being configurable. MDM shall receive feedback on action taken on the service order and track the status of service orders until resolution.
c. Service order tickets could be generated by MDM but processed and closed under jurisdiction of the HES-NMS combine. If the OPTCL already has a separate Workforce Management System (WFM), then the service order tickets can be routed from the MDM and the NMS to the WFM for completion of the tasks and reporting.

E.2.5.8. Customer Service Support

a. The solution shall provide customers with access to current and historical consumption and interval data, outage flags, voltage and power quality indications. The data shall be displayed in graphical and tabular form depending on user choice. The Customer may also access data through customer portal. The solution shall integrate via a user friendly graphical interface.
b. MDM shall support email/SMS notification of configured alarms & events to selected users.
c. The MDM shall support the web portal or shall have the ability to interface with the 3rd party portal/OPTCL portal to provide the consumer near real time online views of both usage and cost and helping consumers to understand electricity usage and cost information, alerts and notifications and energy savings tips with different levels of detail. The portal should support the view for past electricity usage, last week's, yesterday's, current days or other period etc. as per selection. The portal should provide user friendly access to consumer for their data via colorful graphs and charts and can download the data into a spreadsheet.
d. Shall support mobile app through which consumer shall be able to log in through android/iOS/Window based mobile app to see information related to his energy consumption. App shall also provide platform for implementation of peak load management functionality by providing existing tariff & incentives rates, participation options etc.

E.2.5.9. Revenue Protection Support

a. Ability to analyze meter tampering flags, power outages, usage trends and usage profiles to identify potential energy diversion situations, and produce daily reports, monthly reports and service order requests for investigation.
b. The business rules for revenue protection alerts shall be configurable via a user-friendly interface.
c. The MDM shall filter out revenue protection alerts that may be caused by field activities if the field activity information is provided to the MDM.

d. The MDM shall support the analytics/investigation (i.e. view current and historical usage patterns) to validate suspected revenue protection issues.

E.2.5.10. Analytics

The MDM shall have analysis capability based on configurable business rules including but not limited to the following:

a. Display consumption/load profiles by configurable period (15/30 min, hour, day, month, year etc.) day type (weekday, weekend, holiday, festival wise etc.) and by tariff, customer type (hospitals, schools, govt. offices, multiplexes, commercial, residential, industrial etc.), or any user specified collection of meters.
b. Generate peak & off-peak load patterns by aggregating all loads of consumer group/consumer type/DT/Feeder over configurable period/day type.
c. Perform DT/feeder wise energy audit for configurable period. These energy audit reports shall clearly bring out the technical losses at Feeder level and DT level through detailed analysis of supply side energy data and corresponding aggregated consumption data of connected consumers. In this analysis it has to factor in data of energy export from net-metered consumers
d. Perform load analysis for different groups and categories of consumers.
e. Ability to provide the data to load forecasting, load research or demand response applications and perform error management like: Missed reads and intermittent meter reads before sharing data with load forecasting, load research or demand response
f. Ability to configure the system to effectively visualize consumption trends, identify unusual patterns, and visualize load analysis to understand which assets are being over utilized.
g. Analyzing data to identify new patterns of usage, Setting fraud alert / transformer overload alerts / demand – supply gap alert etc.
h. Ability to receive and store outage and restoration event data from smart meters and outage systems and to log all such events for analysis. Five reliability indices shall be calculated,
    i. System Average Interruption Duration Index (SAIDI), which is sum of all customer interruption durations in a given period over total number of customers served.
    ii. System Average Interruption Frequency Index (SAIFI), which is the total number of sustained interruptions in a given period over total number of consumers served.
    iii. Consumer Average Interruption Duration Index (CAIDI), which is sum of all customer interruption durations in a given period over the total number of sustained interruptions in that given period
    iv. Consumer Average Interruption Frequency Index (CAIFI), which is the total number of sustained interruptions in a given period over the total number of distinct consumers interrupted in that given period

    Momentary Average Interruption Frequency Index (MAIFI), which is the total number of customer interruptions less than the defined time (1 or 5 minutes) over the total number of customers served.

    These reliability indices shall be calculated for each month, for individual feeders and aggregated annually for the whole OPTCL. The source data for outage shall be last gasp and the first breath messages from DT/Feeder level meters. These computations shall be independent of similar computations made by any OMS application.
i. Ability to alerts on DT/ Feeder level overvoltage & back-to normal event and under-voltage and back-to-normal events. Based on these alerts the system should calculate the duration in which the DT/Feeder remained outside the nominal zone of defined voltage. Similar calculations should be allowed for power factor and current unbalance.

j. Identify & visualize poor performing assets like feeder/DT on multiple criteria like energy losses, outage duration etc. through appropriate colour coding depending on severity thresholds.
k. Analyze data of net-metering consumers to identify patterns of energy export to grid on hourly/weekly/monthly/yearly basis.

E.2.5.11. Reporting

The Report function shall enable the OPTCL to deliver reports in standard digital format such as PDF, Excel, etc. All queries for report generation shall be made through user driven drop down menu in GUI. The Bidder shall provide example queries to support internal report generation needs. The GUI shall have provisions to set up or change report delivery to configurable email addresses, network file directories, ftp sites or printer systems without modifying source program code and without any proprietary language skills.

The solution shall support users modifying standard reports to better meet specific reporting requirements. The list of the standard reports that shall be provided with the MDM include but not limited to following:

a. Daily data collection report
b. Usage exceptions
c. VEE validation failures
d. Missing interval Read date and times (on hourly, daily, weekly & monthly basis)
e. Physical meter events (install, remove, connect, disconnect) & meter reset report
f. Meter flags
g. Meter inventory
h. defective meters
i. AMI performance measurements
j. Threshold Exception
k. Ability to provide daily & weekly interface exception reports between MDM and other subsystems e.g. billing, outage, etc.

Following high level reports for OPTCL Management shall be generated at specified frequencies to help management with business decisions.For purpose of generating these reports, the system shall be capable of receiving data from external system through standard interfaces via CIM / XML.

<Below is an example of reports[1] that may be generated. These reports should be defined and agreed between PFCCL and OPTCL>

Category	Report	Frequency
Energy Audit	Energy Audit Report: J A daily automatic feeder loss report (Feeder Head reading minus summation of all DT meters readings) J Automatic LT Energy loss report (DT meter reading minus summation of readings of all those consumer meters served by the selected DT) would be reported J Identify the top <X> best as well as worst	Daily, Monthly and User Selectable Time Period with configurable near real time alerts for exceeding defined loss threshold

[1] These reports shall be generated provided the corresponding DT/ Feeder data is available as part of the AMI system being installed.

Category	Report	Frequency
	performing feeders and DTs	
Reliability Indices	SAIFI and SAIDI; CAIFI and CAIDI; MAIFI of the feeder(s) and connected consumers would be tracked to measure the improvement in the same overtime and establishing reference levels	Daily, Monthly and User Selectable Time Period
Load Management	DT Loading (Categorize DT as overloaded, optimally loaded, near-optimal, under loaded)	Daily, Monthly and User Selectable Time Period with configurable near real time alerts
	Load recording (Consumers): Actual consumption recorded higher than the sanctioned load identifying the top <X> consumers	Daily, Monthly and User Selectable Time Period with configurable near real time alerts
	Load Management Report (Identify top overloaded DTs)	Monthly and User Selectable Time Period
Power Quality	Voltage Deviation Index and Frequency Deviation Index (DT/ Feeder)	Daily, Monthly and User Selectable Time Period with configurable near real time alerts
	Low Power Factor (DT/ Feeder)	Daily, Monthly and User Selectable Time Period with configurable near real time alerts
	Meter Current Unbalance (DT/ Feeder)	Daily, Monthly and User Selectable Time Period with configurable near real time alerts
Commercial Loss Detection	Tamper Alert: as per IS 15959 Part 2	Daily, Monthly and User Selectable Time Period with configurable near real time alerts
	Comparison Consumption (system used to detect & track theft suspects)	
	Consumption lower than the expected pattern (pattern of previous year applied to the monthly average) or monthly average	
Management Summary Report (Dashboards)	Summary report on top <X> high loss DTs/ Feeders, top overloaded DTs/ Feeders, Top feeders/ DTs with most outages (number and duration), Top feeders with most power quality issues (over voltage, under voltage, current unbalance, out of band frequency), DTs with high failure rate	Monthly and User Selectable Time Period

Further, the report function shall generate reports on the following project KPIs for a user configurable time period. This will enable tracking the progress of project benefit parameters.

E.2.5.12. Additional Features

a. Prepaid functionality

The prepaid functionality can either be availed at smart meter level or through MDM. In case of MDM, following shall apply

i. The MDM should support pre-payment metering and capability to interface with pre-payment application.
ii. The prepayment should support the system that payment and connection parameters are stored centrally and the details are being updated to consumer portal/ app.
iii. The system should periodically monitor the energy consumption of prepaid consumer and decrease the available credit based on consumption.
iv. The system should send connect/disconnect command on the basis of available credit as per notified rules & regulations.
v. The system should send low-credit notifications to the consumer when their balance approaches a threshold.

b. OPTCL User Interface

User interface for OPTCL shall have ability for at least the following functionality:

i. Compare total energy costs on one rate schedule vs. one or many alternative rates.
ii. Enable the user to see how different options within a rate affect costs.
iii. Display meter data at a user defined configurable cycle through a GUI that allows authorized users to view energy usage patterns and the data behind them for selected customers.
iv. Allow authorized users to view metered data, initiate and view reports, modify configurations, and initiate and update service requests via a GUI.
v. Display via a GUI the energy usage profile for a single meter or group of meters. The load profile shall illustrate energy consumption and peak demand in user defined intervals for a user-specified time period.
vi. Display via a GUI the energy usage profile for a single meter or group of meters according to Time of Use (ToU) tariff.
vii. The GUI shall support a configurable OPTCL dashboard for Operations and OPTCL Management
viii. Access to a minimum of 5 years of historical energy usage and meter reads through the GUI.
ix. GUI to clearly and visually distinguish between metered, estimated, allocated and substituted data.
x. GUI to provide role-based access based on user identity and user role. Shall have following types of users:
   - Administrator
   - Operator
   - Field staff
   - Viewer/Guest
xi. Configure the look, feel, and functionality of the MDM in accordance with business needs, business processes, and business conventions. (E.g. GUI, content, look and feel of screens, validation rules, exception handling, etc.).
xii. Ability for OPTCL through user interface to set up alarm and event notifications that can be directed to a combination of configurable email addresses, cellular text messages or phone numbers.

xiii. User interface for OPTCL to update the credit amount of prepaid consumers to MDM. Such type of user interface before login shall require password & login ID for authentication. User interface after getting information like consumer id., mobile number & recharge amount etc. shall update the same to MDM. The details of payment information shall also update to consumer through SMS, email etc.

E.2.5.13. Integration with other Systems

MDM shall interface with other OPTCL systems on standard interfaces, and the data exchange models and interfaces shall comply with CIM / XML / IEC 61968/ MultiSpeak / IS15959. MDM solution shall be Service Oriented Architecture (SOA) enabled.

The aim of the above interface standards is to ensure generic two way interfacing of the MDM with 3rd party applications. Towards this <OPTCL> shall make arrangements to provide documented information on interface detail and specificity in implementation, of its existing legacy systems, which need to interface with the MDM.

MDM integration with other systems shall include but not be limited to the following:

a. OPTCL Administration
b. HES for data exchange with AMI solutions
c. Billing and collection system like Base Computing System (BCS)
d. Existing other Data Collection Systems
e. Support of interface with HHU or manual reading system etc.
f. Consumer Portal

The supplied MDM shall be ready for integration with IVRS, CRM, GIS and CIS systems of the OPTCL based on the standard interfaces as mentioned above.

Contractor should provide suitable number of HHUs to read and update the data in MDM to meet contingency requirement in case of communication failure between meter and HES/MDM.

E.2.6. Customer Portal

Customer Portal solution shall be based on Web as well as Mobile based native apps that provide on-line two-way communication between OPTCL and its customers. The solution shall integrate via a user-friendly graphical interface. It shall provide for self service capabilities like usage management, billing, service requests, participation in energy efficiency programs etc. Features shall include:

a. The consumer portal solution shall provide customers with access to current and historical consumption and interval data, outage flags, voltage and power quality indications for selected period.
b. The portal/MDM shall support communication preferences for notification via email/SMS of configured alarms & events to selected users.
c. The web portal or 3rd party portal/OPTCL portal to provide the consumer near real time online views of both usage and cost differentiating high energy usage periods, helping consumers to understand electricity usage and cost information, alerts and notifications and energy savings tips with different levels of detail. The portal should support the view for past electricity usage, last week's, yesterdays, current days or other period etc. as per selection. The portal should provide user friendly access to consumer for their data via colorful graphs and charts and can download the data into a spreadsheet.
d. Consumer mobile app through which consumer shall be able to log in through android/iOS/Window based native mobile app to see information related to its energy

consumption. App shall also provide platform for implementation of peak load management functionality by providing existing tariff & incentives rates, participation options etc.

e. Provide cross-browser compliant software (compatible with Internet Explorer, Chrome, Firefox, and Safari)
f. The portal shall be linked to the on-line payment facility and gateway of the OPTCL.
g. Pre-paid consumers shall be provided facility to recharge their account
h. Shall support the OPTCL and in turn its customers with a system for logging, managing, and communicating technical issues.

User interface to consumer portal to access consumer's data from MDM for all authorized consumers shall have ability for at least the following functionality:

a. The UI of the Portal shall allow selection of preferred language for dialogue like English, Hindi or any Local language
b. View metered data, initiate and view reports
c. View data according to Time of Use(ToU) tariff
d. Can make request for connection/disconnection
e. User can update mobile number/email
f. Can initiate service requests for maximum demand updating, meter checking etc.
g. In case on net-metering consumers, user can view data for both import & export
h. In case of prepaid consumers, consumers can view recharge history & present balance.
i. User interface shall require consumer id., mobile number & password for secure login.

Software patches, updates, and minor version upgrades, when they become available for general release, should be part of ongoing support and maintenance services.

F. SCADA DMS OMS FUNCTIONAL REQUIREMENT

The intent of this specification is to establish (i) SCADA/DMS System along with RTUs/FRTUs (ii) Associated Auxiliary Power Supply System (iii) Communication System (iv) integration with IT system under R-APDRP or any legacy system (if applicable). The functional details are given in respective chapters of the specification.

Configuration of Data centre (Schematic configuration diagram)

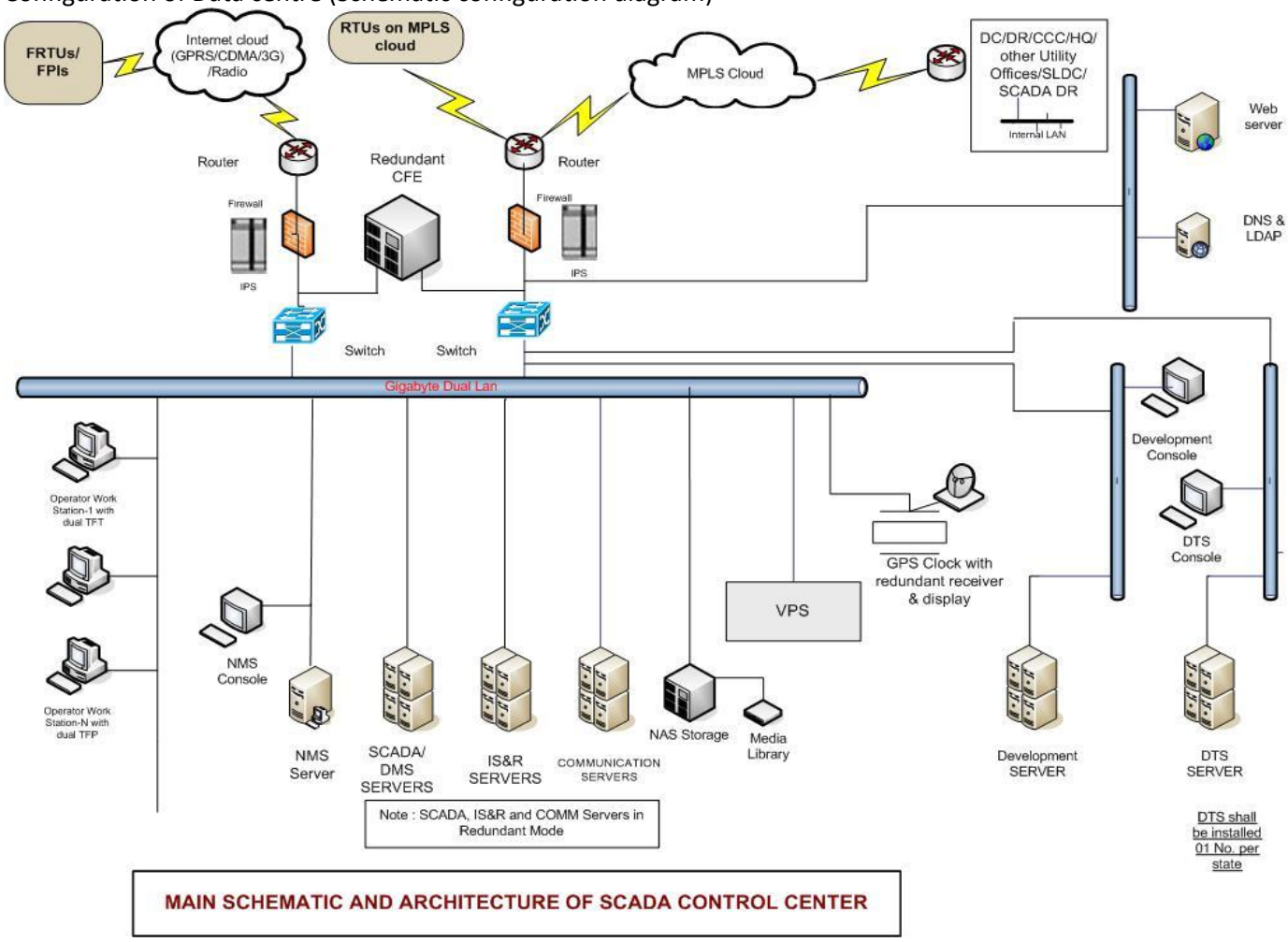


Figure-1

NOTE;

SCADA/DMS, ISR, COMMNUICATION, CFE, NMS, DMZ, WEB, DIRETORY (LDAP), DR SERVER ARE SHALL BE DUAL REDUNDANT. DMS & SCADA /DMS LAN SHALL BE DUAL & DTS, DEVELOPMENT

F.1 Scope of Work

The successful bidder shall act as the SIA. The SIA in coordination with OPTCL (as per the requirement to be given in the detailed RFP) shall carry out field survey, design ,engineering, supply, installation, testing & commissioning of SCADA/DMS software applications, Dispatcher Training Simulator (DTS) , hardware (including PCs, Servers, Routers, Switches, VPS, RTU, FRTUs, Multi function Transducers (MFTs), Communication equipment , Auxiliary power supply etc), software (including operating system, databases, network management system etc.), network (LAN, WAN), etc.

Integration with existing /under implementation IT system under R-APDRP & any other relevant SCADA/ DMS legacy system in the identified project areas of the OPTCL

The SIA shall, with the help of the Purchaser integrate the SCADA with the State Load Dispatch Center (SLDC). The purchaser shall do the necessary agreements with data exchanges with the SLDC and facilitate necessary help to SIA

Facilities management services for maintaining infrastructure, post successful completion of acceptance tests for a period of five years from the date of completion of acceptance test.

Major components that a SCADA /DMS implementation would include are given as under.

- SCADA/DMS/OMS Control Centre
- SCADA/Information Storage & Retrieval (ISR) Functions
- DMS Functions
  - Network Connectivity Analysis (NCA)
  - State Estimator (SE)
  - Load Flow (LF)
  - Voltage VAR Control (VVC)
  - Load Shed application (LSA)
  - Restoration Fault Management and System Restoration (FMSR)
  - Feeder Reconfiguration, Loss Minimization, Load Balancing, etc (LMFR,LBFR)
  - Operation Monitor (OM)
  - Distribution Load Forecasting(DLF)
- SCADA/DMS/ Dispatcher training simulator (DTS)
- RTUs at all primary S/S & FRTUs at RMUs, /Auto Reclosures/Sectionalizers on HV Distribution network etc.
- MFTs at Feeder, RMUs
- Secured Communication using VPN/SSL
- FO Ring/MAR/VPN, Broadband, leased line, etc., connecting all S/S RTUs to Main & DR centre
- Secured CDMA/GPRS/Radio based communication, etc. for communicating with control centres

Protocols for communication: (The following is only an indicative list of protocols, the supplier can suggest other communication protocols with diffferent devices in order to meet the performance requirements)

- IEC 60870-5-104 –RTU, IEC 60870-5-104/101 for FRTUs, FPI to control centres.
- MODBUS or IEC 60870-5-101/104 – MFTs to RTUs/FRTUs
- ICCP (TASE.2) between SCADA/DMS Control centre /DR centre & state load dispatch centre
- Support /compliance to IEC61850 ,IEC60870-5 suite for RTU/CC.

Conducting Factory Acceptance Test (FAT), Site Acceptance Test (SAT), Type test (as required), etc. successfully, Go live, operational acceptance & handing over to customer.

The key components of the model RFP includes & not limited to following:

1. Hardware: Site survey, planning, assembly/ manufacturing, design & Engineering, Supply, loading, transportation, unloading, insurance, delivery at site, handling, storage, installation, testing, commissioning and documentation of all necessary hardware and networking equipments and its connectivity, as specified in the detailed specifications. The SIA shall take the responsibility to install the servers, RTU/FRTU, MFTs, Video Projection System (VPS) switches, routers, backup and tape devices, Workstation PCs, Aux Power supply, communication equipment etc and other necessary hardware/software at the sites. The SIA shall provide the time frame for procuring and delivering all the necessary hardware. Though the scope covers establishment of a SCADA/DMS control centre along with associated hardware and software, the SIA shall design and provide the Software & hardware at SCADA/DMS control centre including RTU/FRTU locations with 100% expandability for future growth in electrical distribution network

of the city. The delivered hardware (Processor ,HDD, RAM &software) for servers, PCs ,RTU, FRTU etc shall be sized for ultimate system sizing while maintaining the performance, availability & functions as per specification. . However, other items such as I/O modules, additional workstation can be added as per the growth in the network The SIA shall provide the necessary design & engineering documents, drawings and plan, sizing, cabling and connectivity and the bill of material, etc. & obtain approval from OPTCL

2. Software: Site survey, planning, assembly/ manufacturing, design & Engineering, Supply, loading, transportation, unloading, insurance, delivery at site, handling, storage, installation, testing, commissioning and documentation of operating systems at servers/desktops, database and SCADA/DMS application software, etc.

3. Facilities management services (FMS) for maintaining infrastructure, post successful completion of acceptance tests for a period of five years from the date of completion of operational acceptance of the SCADA/DMS System.

   Except for civil work the SIA undertakes all responsibility for establishing and operating the SCADA/DMS-OMS control center (CC) as outlined below.

   The SIA shall undertake the complete procurement of materials, installation, testing and commissioning of all components SCADA/DMS-OMS center. No additional payments shall be made to the SIA, successful bidder for any spares/license, equipment or in any other regard for the establishment of the SCADA/DMS-OMS system.

   The SIA shall be responsible for all spares/replacements, licenses and all other components for the correct and optimum functioning of the SCADA-DMS-OMS center. No additional payments shall be made to the SIA, successful bidder for any spares/license, equipment or operations of the SCADA/DMS/OMS system.

   The Supplier shall be required to provide the services under FMS so as to manage SCADA / DMS –OMS system including all equipments, installations including hardware, software & networks installed & commissioned by Contractor for the OPTCL in order that they meet the availability requirement as specified in the document.

   To achieve the desired Service Levels, the SIA may need to interact, coordinate and collaborate with the other Service Providers as required. The SIA will act as the Single Point of Contact for all issues relating to the Service Levels. The SIA will have the responsibility to deal with the other members of the consortium and vendors (during warranty period) /other vendors as selected by Purchaser (after warranty period) as the case maybe, to provide the services at agreed service levels.

4. System Design and Engineering: The SIA shall be responsible for detailed design and engineering of overall system, sub-systems, elements, system facilities, equipments, services, including systems application software and hardware etc. It shall include proper definition and execution of all interfaces with systems, equipment, material and services of OPTCL for proper and correct design, performance and operation of the project.

   SIA shall provide complete engineering data, drawings, reports, manuals and services offered etc. i.e. complete set of documentation /drawings for Purchaser’s review, approval and records.

5. Supply of Equipment and Material: The SIA shall also be responsible for manufacture, inspection at manufacturer's works, supply, transportation, insurance, delivery at site, unloading, storage, complete supervision, installation and successful commissioning of all the equipment, systems and application software. The proposed delivery should be state of the art in architecture and engineering practices.

   Any item though not specifically mentioned, but is required to complete the project works in all respects for its safe, reliable, efficient and trouble free operation & to meet performance ,availability & functional requirements as envisaged in the RFP shall also be taken to be included, and the same shall be supplied and installed by the SIA without any extra cost.

6. Testing and Commissioning: The SIA shall be responsible for the testing processes such as planning (includes preparing test plans and defining roles and their responsibilities), preparation (consists of preparing test specification, test environment and test data) for all tests viz. Type tests, FAT, SAT and successful commissioning.

7. Integration Scope: SIA should ensure that legacy systems (if any) and the new solutions lined up by them are tightly integrated and do not remain stand-alone and shall perform on real time basis as envisaged in specifications. All required external systems shall be integrated using an integration middleware layer. The scope of integration of external systems includes (if any), legacy SCADA/DMS system, RTU/FRTU, IT systems under R-APDRP including billing , customer care(if required), GIS etc already existing and functional in the OPTCL, but outside the present scope of work. The integration is expected to be Industry Standards Based on IEC 61968-1 Bus (SOA Enabled on enterprise Bus) using CIM/XML, OPC, ICCP etc., which is, on-line, real time or offline where appropriate and shall operate in an automated fashion without manual intervention, which is documented for future maintenance.

   SIA shall make necessary provisions/software linkages in the proposed solution so that the IT system or any legacy SCADA/DMS system may be integrated seamlessly.

8. Training for Employees: The SIA shall organize training to the core Group of implementation team of the OPTCL as well as end user training. Representatives from the Purchaser's implementation project and change management teams will be involved throughout in the development of training strategy, training material design and development, standards and training delivery to ensure that change management issues are incorporated, and that training strategies and materials are aligned to the requirements of the project and as business-specific as possible.

9. Progress Update: The SIA may also provide periodic status update reports highlighting critical issues to the Purchaser. Further, any information (progress report, etc.) as and when sought by the Purchaser shall be furnished by the SIA.

10. In addition to the above, following works are also in the scope of the contractor:
    - Database and display development
    - Training
    - Obtaining the statutory clearances required, if any, from Ministry of Communication/ Govt Authority.

    The Purchaser may extend support in form of a letter or overall communication with concerned agencies on a need basis if required. The responsibility for getting timely clearances from concerned departments would lie with SIA.

11. Other Services and Items: The scope also includes, but not limited to the following services/items described herein and elsewhere in specification:
    a. Project Management and Site Supervision: The bidder shall be responsible for the overall management and supervision of works, including the implementation of risk management as well as change management initiatives. He shall provide experienced, skilled, knowledgeable and competent personnel for all phases of the project, so as to provide the Purchaser with a high quality system
    b. Interface Coordination: The bidder shall identify all interface issues with OPTCL and other agencies if any, and inform OPTCL which shall interface, coordinate and exchange of all necessary information among all concerned agencies.
    c. Scope Change Management: OPTCL to finalize the scope change management procedure during development/Implementation stage.

12. Specific Exclusions:
    a. All civil & architectural works, internal and external electrification, special electronic earthing for Server system, Air conditioning and ventilation, fire fighting system and Access control system required for SCADA/DMS system are outside the scope of the SIA, however SIA has to indicate the space requirement for SCADA/DMS control centre , DR centre, RTU / FRTU/Auxiliary power supply & communication equipment any other specific requirement, power supply requirement including standby supply requirement, so that the OPTCL can provide the same as per bidder's requirement
    b. A.C. input power supply

13. The detailed technical requirements including Bill of Quantity of the above components is described in subsequent sections of this volume.

14. The responsibility of the SIA shall include supplying, laying and termination of the cables, wherever required for:
    a. Acquiring analog data using MFT, transducer, sensor which shall be connected with the primary devices.
    b. Acquiring the digital data for status of field devices relays in the control room.
    c. Extending control output to field devices through heavy duty relays
    d. Interconnection between Contact Multiplying Relays (CMRs) and RTUs/FRTUs & field devices (CMRs to be supplied by the contractor as per BOQ),
    e. Power and signal cabling between the supplied equipment & Owner's equipments.
    f. Any other cabling required for completion of the project.

F.2 Generic requirements:

The SIA shall undertake detailed site survey immediately after award of the contract, to address the various requirements such as space, identification of input terminals, and availability of air-conditioning, spare contacts etc for completion of engineering, site installation, testing and commissioning of the project. The type and number of hardware and software elements (Bill of Quantity) within the scope of the project to be supplied for the various sites are identified in the Appendices. The individual functions to be performed by the hardware and software and system sizing criteria are described in the relevant sections. The specification defines requirements on functional basis and does not intend to dictate a specific design. On the other hand certain minimum requirements must be met in accordance with the particular details provided elsewhere in the specification.

The items, which are not specifically identified but are required for completion of the project within the intent of the specification, shall also be supplied & installed without any additional cost implication to the Purchaser.

The Bidder's proposal shall address all functional, availability and performance requirements within this specification and shall include sufficient information and supporting documentation in order to determine compliance with this specification without further necessity for enquiries.

An analysis of the functional , availability and performance requirements of this specification and/or site surveys, design, and engineering may lead the Contractor to conclude that additional items and services are required that are not specifically mentioned in this specification. The Contractor shall be responsible for providing at no added cost to the employer all such additional items and services such that a viable and fully functional system is implemented that meets or exceeds the capacity, and performance requirements specified. Such materials and services shall be considered to be within the scope of the contract. To the extent possible, the Bidders shall identify and include all such additional items and services in their proposal.

All equipment provided shall be designed to interface with existing equipment (if any) and shall be capable of supporting all present requirements and spare capacity requirements identified in this specification.

The offered items shall be designed to operate in varying environments. Adequate measures shall be taken to provide protection against rodents, contaminants, pollutants, water & moisture, lightning & short circuit, vibration and electro-magnetic interference etc.

The SIA shall demonstrate a specified level of performance of the offered items during well-structured factory and field tests. Further, since at the substations limited space is available the contractor shall make all the efforts to economize the space requirement.

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

The successful bidder (SIA) is required to visit all sites. The site visits after contract award shall include all necessary surveys to allow the contractor to perform the design and implementation functions.
After the site/route survey the Contractor shall submit a survey report for all the sites. This report shall include at least the following items, however, the exact format of the report shall be finalized by the SIA with the approval of Purchaser.

a. Proposed layout of Equipment in the existing rooms and buildings.
b. Proposed routing of power, earthing, signal cables and patch cords etc.
c. Confirmation of adequacy of Space and AC Power supply requirements
d. Proposals for new rooms/buildings, if required.
e. Identification of facility modifications, if required.
f. Identify all additional items required for interconnection with the existing equipment.
g. Requirement of Modification to existing earthing arrangement, if any.

F.3 General Bidding Requirements:

The computer hardware shall be of current industry standard models as per section2 hardware chapter. The Bidder shall be responsive to the technical requirements as set forth in this specification. To be considered responsive, the Bidder's proposal shall include the following:

a. A detailed project implementation plan and schedule that is consistent with the scope of the project. The plan shall include all the activities required, show all key milestones, and clearly identify the nature of all information and project support to be provided for completion of the project. Manpower resources, proposed to be deployed by the Contractor during the execution phase, shall be clearly indicated.

b. Documentary evidence in support of the qualifying requirements specified in the bidding document i.e. RFP shall be submitted along with the bid.

c. Performance certificate for the offered equipment/systems from the user's in line to the requirements mentioned in the biding documents.

d. The type test certificates for the offered equipments. In case it is not type tested. The commitment for same to be conducted during implementation.

e. Completed equipment Data Requirement sheets/Questionnaire.

f. Technical details of the offered equipment/systems.

F.4 Items of Special Interest:

To assist in understanding the overall requirements of the project, the following items of special interest are listed. The Bidder shall pay particular attention to these items in preparing the proposal. The SIA shall be responsible for overall project management, system integration and testing to complete all the facilities under the project.

a. The project shall be implemented in the time schedule described in vol-I.

b. The database, displays and reports for SCADA/DMS system are to be developed by the SIA; however, the contractor shall associate the Purchasers engineers also during the data base development. The required hardware & software for completion of this activity may be used out of the hardware & software to be supplied under this contract.

c. The APIs (Application Program Interfaces) specified/needed section 2 are to be supplied. However the supply of source code is not mandatory.

d. SCADA/DMS system, shall exchange data with IT system.

e. The SIA is expected to bring in the following: Review of processes currently followed by the purchaser and suggest process based on best practice w.r.t to display, the SIA should advise on the criticality of various parameters.

F.5 Applicable Standards:

The applicable standards are mentioned in the respective technical section. The offered equipment shall conform to the standards mentioned in the specification except to the extent modified by this specification. In case of any discrepancy between the description given in the specification and the standards the provisions of the technical specification shall be followed. The parameters not specifically mentioned in this specification shall conform to the standard mentioned in this specification.

Wherever, new standards and revisions are issued during the period of the contract, the SIA shall attempt to comply with such standards, provided there is no additional financial implication to employer/owner.

In the event the SIA offers to supply material and/or equipment in compliance to any standard other than those listed herein, the Contractor shall include with their proposal, full salient characteristics of the new standard for comparison.

F.6 Warranty:

This would include five years warranty for the related hardware & software supplied under the SCADA/DMS-OMS project after the operational acceptance of the SCADA/DMS System. The five year warranty shall include comprehensive OEM on-site warranty for all components (H/W and Software including OS) supplied including reloading and reconfiguration of all Software and device drivers/patches etc. if required.

F.7 Terms for OPTCL& SIA:

The term contractor & bidder shall be referred as SCADA/DMS implementation agency (SIA) & owner, employer, Purchaser shall be referred as OPTCL where ever mentioned in the RFP.

F.8 SCADA FUNCTIONS

F.8.1. General requirements

This section describes the functions to be performed by the SCADA applications for distribution system for the project area. Bidders are encouraged to supply standard, proven & tested products that meet or exceed the Specification requirements. This chapter describes the requirements of ISR functions also. Unless specified as optional functions/ features all functions/ features mandatory for the project area.

F.8.2. Design requirements:

The software shall be modular in nature. The software shall be able to work on a platform based on minimum 64 bit architecture. All the variable parameters of SCADA/DMS-OMS applications, which require adjustment from time-to-time, shall be defined in the database and shall be adjustable by system personnel. All periodicities and time intervals contained in the Specification that define these parameters shall be considered as initial values to be used for performance purposes. The adjustments made to parameters by the user or programmer shall become effective without having to reassemble or recompile programs or regenerate all or portions of the database.

The specific requirements for output results are described along with the other requirements of each function. However, all results that the user/Purchaser deems to be important shall be stored in a form accessible for display and printing, whether or not explicitly specified in the particular subsection.

F.8.3. SCADA/DMS Function Access:

Various application functions shall be designated as single user/ multi-user. For a single-user function, the user with access to the function must relinquish access to it before access can be granted to another user. For a multi-user function any number of users, up to the maximum designated for the function, may have access to the function simultaneously. All such actions shall be recorded as events in the event log

F.8.4. Critical & non-critical functions:

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

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

Generally the following are to be classified as Critical functions

a. All SCADA applications
b. Information Storage and Retrieval (ISR)
c. All DMS applications
d. Data exchange among the contractor supplied SCADA/DMS system, IT system established under R-APDRP
e. Web server applications , Security applications
f. Network Management system (NMS)
g. Data recovery function (DR)

The following are Non-Critical functions

a. Dispatcher Training Simulator (DTS)
b. Database modification and generation
c. Display modification and generation
d. Report modification and creation
e. Data exchange with Remote VDUs ,if any.

F.8.5. Communication protocol:

SCADA system shall use the following protocols to communicate

a. for RTU - IEC 870-5-104 protocol also 101 to communicate when acting as data concentrator with slave devices
b. for FRTU- IEC 870-5-101 /104 protocol
c. for FPIs - IEC 870-5-101 /104 protocol
d. for MFTs – MODBUS
e. for DR & Other any other SCADA system - ICCP/TASE.2 in specified format (OPC / CIM-XML / ICCP / ODBC Format) Model & Data Exchange over IEC 61968-1 Enterprise SOA Based BUS)
f. for IT Systems - (in specified format (OPC / CIM-XML / ODBC Format) Model & Data Exchange over IEC 61968-1 Enterprise SOA Based BUS)

In case existing system uses DNP3.0 protocol, the same shall be used for integration of existing RTUs. The protocol considerations shall be made in accordance to the system/ device to be interfaced. However, system shall have capability to interface using all necessary protocols as specified above for the devices that may be interfaced in future.

The SIA may choose to use other protocol where applicable while ensuring that the SLAs are met and safe and correct system operations is maintained.

F.8.6. SCADA Functions:

The following SCADA functions are envisaged under this specification.

a. Data Acquisition from RTUs at S/S , FRTUs at RMUs /sectionalizer, auto-reclosers & FPIs
b. Time synchronization of RTUs,, FRTUs & FPIs(if time synch is supported in FPI)
c. Data Exchange among the SIA supplied SCADA/DMS system, IT system (in specified format

(OPC / CIM-XML / ICCP / ODBC Format) Model & Data Exchange over IEC 61968-1 Enterprise SOA Based BUS), State load dispatch center (SLDC).

d. Data Processing
e. Continuous real-time data storage and playback
f. Sequence of event processing
g. Supervisory Control
h. Fail-soft capability
i. Remote database downloading ,diagnostics & configuration
j. CIM compliance IEC61968
k. GIS adaptor (GIS Land base data, network model using GIS engines/adaptors supporting Native Adapters , CIM/XML Model for Distribution / Power System, using Model Exchange & Data Exchange over IEC 61968-1 Enterprise SOA Based BUS)
l. Information Storage & Retrieval (ISR)
m. Data recovery (DR)

The System Design Parameters of SCADA/DMS functions ,The power system sizing, Performance requirements for complete SCADA/DMS system are specified are specified in DESIGN PARAMETERS AND PERFORMANCE given section 8 The SCADA system shall have capability to accept data from the following sources:

a. Telemetered data received from RTUs, FRTUs & FPIs and all other devices in the scope of this project
b. Data received from IT systems of the Purchaser as applicable.
c. Data exchange
d. Calculated data
e. Pseudo-data (Manually entered data)
f. GIS land base data, network model using GIS engines/adaptors

System shall provide 30 web based SCADA/DMS-OMS clients for corporate users in remote VDU. The system shall support network view, geographic maps, tabular views, single line diagrams and shall have same look and feel as the real time SCADA/DMS-OMS displays. It will be accessed by diverse set of external users through commercially available web browser e.g. Microsoft Internet explorer, Mozilla etc. It shall also be possible to access the data and display by using mobile phones/ tablets on various OS i.e. Android, iOS, windows etc.

All input data and parameters, whether collected automatically or entered by an user, shall be checked for reasonability and rejected if they are unreasonable. All intermediate and final results shall be checked to prevent unreasonable data from being propagated or displayed to the user. When unreasonable input data or results are detected, diagnostic messages, clearly describing the problem, shall be generated. All programs and all computer systems shall continue to operate in the presence of unreasonable data.

Each of the SCADA functions is described below.

a. Data Acquisition:
   SCADA system shall acquire data from Remote Terminal Units (RTUs) ,FRTUs &FPIsand other devices in the scope of this project.

b. RTU & FRTU:
   The type of data to be acquired through RTUs, FRTUs shall include analog values, digital status data (Double point and single point indications) and SOE data from the substation, RMUs etc. Analog values like P, Q, F, each phase V, each phase I, each phase pf, and energy values (Export/Import KWh and KVARh) shall be collected by the RTU, FRTUs from the MFTs.

Analog values such as station battery voltage, oil temperature, winding temperature, tap changer, weather transducer data etc. shall also be acquired through RTU using analog input modules & suitable transducer, if defined in the RTU BOQ.

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

d. Polling method:
Digital status data from RTU shall be reported by exception and shall be updated and displayed within 4 seconds. Digital status data from FRTU & FPI shall be also be reported by exception and shall be updated and displayed within 6 seconds. Digital status data shall have higher priority than the Analog data. The system shall have dead band for data by exception.

All analog values except energy values shall be reported by exception from the RTU, FRTU & FPI. The analog value, when reported by exception, shall be updated & displayed within 5sec from S/S & 10sec from RMU/sectionalizer locations at the control centre. An integrity scan of all status & Analog values shall also be made every 10 minutes (configurable).

The provision shall also be made to report analog values & status data periodically at every 10sec (user configurable), if required by the user.

The time skew at SCADA/DMS control centre, S/S, RMU,FPI, auto-recloser shall not be more than 0.1sec at each location & latency shall not be more than 0.5sec for status. For analog data the time skew shall not be more than 1sec & latency shall not be more than 1sec for analog as per IEEE C37.1.

Energy values of 15 minute blocks shall be collected periodically from the RTU, FRTU at scan rate of 15 minute/1 hour (configurable upto 24 hours). Alternatively, the energy values shall be calculated for each 15 minute/1 hour blocks at SCADA level from the acquired energy values of MFTs through RTU & FRTU.

The SIA must assess & take the network delay into consideration while designing the system so that the update time in normal & peak level of activities are met.

The SCADA/DMS-OMS computer system shall also be able to collect any and all analog & digital data from its RTUs/FRTU/FPI and other applicable devices on demand. Apart from the periodic integrity scan, the integrity scan shall also be initiated automatically for an RTU/ FRTU/ FPI and other applicable devices whenever the following situations arise:

Upon start up of the system

i. RTU/ FRTU/ FPI status change is detected such as RTU/ FRTU/ FPI restart, Communication Link restoration
ii. On demand by SCADA/DMS functions
iii. On request by the user

The TCP/IP Communication for RTU, FRTU, FPI on public network shall be encrypted over SSL Security / VPN & the equipment should take control command from designated Master IP address only and no other IP. The RTU, FRTU, FPI & all TCP/IP devices that are on Public Network shall

form a private VPN network with the SCADA Front End, through which encrypted data gets exchanged.
The vendor shall ensure that settings related to polling, querying of all connected devices are configurable and can be changed within reasonable limits when so requested by the Purchaser
More information regarding security issues can be found in the cyber security section

F.8.7. Telemetry Failure:

If data is not received from an RTU/FRTU/ FPI after a user-adjustable number of retries, each affected point in the SCADA system shall be marked with a 'telemetry failure quality code' and an alarm shall be generated. Telemetry failure of data can be due to failure of communication link, failure of complete RTU/, FRTU/FPI or RTU/ FRTU module or MFT etc. Only a single alarm shall be generated if an entire RTU/ FRTU or its communication channel fails.

In the event of telemetry failure, the last good value/status shall be retained in the database for each affected point. When telemetry returns to normal, the associated SCADA system shall automatically resume updating the database with the scanned data.

The user shall be able to substitute a value in the database for any point that is experiencing telemetry failure which shall be marked with 'manual replaced' quality code in addition to the 'telemetry failure' quality code. The user shall also be able to delete any point (or entire RTU/FRTU/FPI) from scan processing. All deleted points shall be marked with a 'delete-from-scan' quality code.

a. Acquisition Modes:

The following modes of data acquisition shall be supported:

i. Enable : When RTU/FRTU/FPI is enabled, the data is scanned in normal fashion and control command execution is allowed.
ii. Disable : When RTU/FRTU/FPI is disabled, the data scanning & control execution is disabled. This is equivalent to" delete from scan "of complete RTU.

b. Test /Maintenance

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

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

c. Time synchronisation of RTUs:
i. The SCADA/DMS system will be synchronised from the GPS based Time and frequency system.
ii. The SCADA system shall synchronise the time of all connected RTUs/FRTUs/FPI every 15 minutes (user configurable from 5 minutes to 24 hrs) using time synchronisation message in the IEC 870-5-104/101 protocol /NTP/SNTP.
iii. The servers /Workstations at SCADA/DMS control centre shall be synchronised using NTP/SNTP. The time of DR centre shall also be synchronised from the GPS based system installed in one of the SCADA/DMS control centre in the state.

F.8.8. Data Exchange:

a. SCADA/DMS system with IT system:

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

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

b. For data exchange between SCADA/DMS control centres & DR centre, SLDC:

SCADA/DMS-OMS control centre shall also have provision to exchange data using ICCP with State Load Dispatch Centre (SLDC) of the state if required.Data exchange shall also allow other information to be transferred report by exception but also configurable periodically, or on demand. . It shall be possible to exchange at least the following data:

i. real-time Telemetered data of the interconnected network,
ii. non-Telemetered data of the interconnected network,
iii. calculated data of the interconnected network
iv. SOE data of the interconnected network
v. historical data of the interconnected network
vi. scheduling data
vii. Operator messages.
viii. Event /alarm lists

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

The data exchange with DR is required all the data to be transferred from control centre to DR which is required for system build in order to build a system from scratch. ICCP. TASE.2 protocol or equivalent non proprietary / De-Facto protocol shall be used transfer network model / database changes on incremental /global basis automatically once a day & on demand It shall transfer all data /information which is required for system build in order to build a system from scratch.

F.8.9. Data Processing:

The SCADA/DMS system shall prepare all data that they acquire for use by the power system operations and other applications. The data processing requirements shall apply to data collected from all specified sources. Data acquired from RTUs/FRTUs/FPI/IT system, as well as data received from the DMS-OMS and the existing control centers if any, shall be processed and placed in the Real-Time Database as soon as it is received.

Data processing involves a value which has been converted to internal form and analyzed for violations of limits. The data processing shall set various data attributes depending on the results of the checks and shall trigger any additional processing or calculation. The SCADA /DMS system shall prepare all the acquired data for use by the power system applications. The SCADA system shall have capability to accept data from the following sources:

Real-time (also referred as Telemetered) data received from control centres /IT system (data centre, customer care ,DR centre and RTUs/FRTU/FPI etc)

a. Calculated data

b. Manually entered data
c. Sequence of events data
d. Alternate data sources

F.8.10. Analog Data Processing:

Analog data processing shall be performed according to the requirements listed below.

a. Conversion to Engineering Units

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

Value = (A * scanned valued) + B,

Where A and B are programmer-adjustable constants assignable as database attributes on a per point basis.

b. Zero dead band processing

The SCADA system at control centre shall process each analog input for dead band zone processing. The acquired value, if falls between the dead band range around zero then it shall be considered as clamped zero value else the actual value shall be considered.

c. Reasonability Limit Check

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

d. Limit Monitoring

For bi-directional quantities (positive or negative) there shall be a set of three limits for each direction. For unidirectional quantities there shall be a set of three limits in one direction. These limits will represent increasing levels of concern and shall be named as "Operational", "Alarm" and "Emergency" limits. These three limits shall be set within the boundaries of reasonability limit. Generally, any alarm can be assigned as audible alarm but emergency limit shall necessarily be assigned as audible alarm.

All Telemetered and calculated analog point shall be compared against above sets of high and low limits each time the value is scanned or calculated. Whenever a monitored point crosses a limit in the undesirable direction a limit violation alarm message shall be generated. Whenever a monitored point crosses a limit in the desirable direction, an exit alarm message shall be generated. If multiple limits have been crossed since the last check, each limit crossed shall be reported.

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

The user shall be able to temporarily override any of the above limits (which are in use) by entering a new value. When the user overrides a limit, it shall be marked with a 'limit override quality code' on all displays. The override value shall be recognized, and any display, report, or

log containing the value of the overridden limit shall include it as such. An override value shall be used instead of the permanent value until the user removes the override condition or system is re-initialized. Any change in alarm states resulting from a change in limit value shall be reported. Contractor shall finalise & take approval from OPTCL for limit values.

e. Rate of change /Gradient

All Telemetered and calculated analog points shall be also processed for rate of change of / Gradient processing , if defined that point for such processing in the database . An Alarm for over shoot & event message for return to normal shall be generated. The rate of change shall be calculated periodically for each assigned point, by dividing the point's values at the beginning and the end of the period into the length of the period. Filtering shall be applied so that single scan excursions do not cause an alarm. The result shall be saved as a non-Telemetered database point. All the requirements that apply to calculated points, such as limit checking, alarming and availability for display and processing shall apply to the ROC points. There shall be a positive limit and a negative limit to catch excessive rises in the analog value.

f. Sign Conventions

The sign conventions for the display, data entry and reporting of active and reactive power flow shall be used universally by all SCADA/DMS functions. All imports to bus bars shall be represented with + sign and all exports from bus bars shall be with –ve sign.

g. Accumulator Processing

The system shall be able to store accumulator history. Storing accumulator history shall be provided with a method in which that stores data only once per hour and in other method that stores data each time new data enters the system.

It shall be possible to use the two methods concurrently for any pulse accumulator, making it possible to maintain two records for data that are read more than once an hour.
Digital Input Data processing:

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

i. Illegal state: The first check on a new input to a digital status point is the legality check. If the new state is illegal, then the old value shall be left in the database and marked old with relevant quality code such as telemetry failure etc.
ii. Abnormal state: If the new state is legal, it shall be checked to see if it is among the normal states defined for the point. If not, the status point shall be marked as abnormal. While abnormal, it shall appear in the summary display of abnormal conditions/ off-normal summary
iii. Alarm checking: Each new value shall be checked to see if transitions into that state are to be alarmed. If so, and if no control action is pending on the status point, then an alarm action shall be triggered.

The following digital input data types shall be accommodated as a minimum:

i. Two-state points: The following pairs of state names shall be provided as minimum:
   (1) Open/Closed
   (2) Tripped/Closed
   (3) Alarm/Normal

(4) On/Off
(5) Auto/Manual
(6) Remote/Local
(7) On Control/Off Control

ii. Three-state points: Any of the state combinations listed in (i) above shall be supported with a third, typically, in-transit state which is the case for slow operating devices such as isolator. If a device remains in this state for a period more than a threshold value, the same shall be alarmed.

Momentary change Detection (MCD): The input to capture the states of fast acting devices such as auto recloser.

Commanded changes initiated by supervisory control shall not be alarmed but shall generate an event message. All other status changes in the state of telemetered, calculated digital input points & uncommanded changes shall be alarmed . Each CB, isolator switching device etc shall have normal & off normal positions states defined. In the event of off normal positions, the same shall be reflected in the off normal summary list
Calculated Data processing:

SCADA system shall be capable of performing calculations and storing the result in the database as calculated data available for display. The database variables to be used for arguments and the mathematical/statistical/logical functions to be used as operations shall be definable interactively at a console as well as by the programmer using database creation and maintenance procedures.

Calculated analog values shall use database points as the arguments and mathematical and statistical functions as the operations. Functions such as addition, subtraction, multiplication, division, maximum value, minimum value and average value, count, integration, square root extraction, exponentiation, trigonometric functions, logarithms and logical & comparative operators etc shall be provided.

It shall be possible to calculate running maximum value, minimum value and average value over a time interval (time interval configurable from 5 minutes to 60 minutes). The value shall be reset after the elapse of defined time interval. These values shall be stored with time of occurrence for maxima and minima and the time for averaging. Calculated status values shall use database points as arguments and combinational logic functions that include the logical, comparative operators such as AND, inclusive OR, exclusive OR, NOT, Less Than, Greater Than, Less Than or Equal To, Greater Than or Equal To, and Equal To ,If , else if etc. Suitable rules or operators (such as multi-level parentheses) shall be provided to indicate the sequence of operations in the calculation.

F.8.11. Substation Topology Processing:

The SCADA /DMS system shall be provided with a Substation topology processor function. This function shall be capable of analyzing the open/closed status of switching devices, such as breakers and disconnectors, in order to define the configuration of the substation for display.

The energization of lines, transformers, bus sections and generating units shall be determined so that the associated displays may correctly show the status of these power system elements. The configuration shall be re-evaluated and updated whenever a switching device status change & analog value change beyond dead-band is detected.

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

b. Quality Codes:
Quality codes indicate the presence of one or more factors that affect the validity of a data value. All quality codes that apply to a data value shall be maintained in the database for that data value.

The quality of the calculated value shall be the quality of its "worst" component of its arguments. The presence of a quality code on any of the component data values shall not disrupt the calculation using that value . Results of calculations that are manually overridden by the user shall be denoted with a quality code that can be differentiated from the propagation of a manual replaced quality code from one of its component values.

At least the following data quality codes preferably as the following single letter code shall be provided. However, distinct symbols /shapes after approval from employer may also be used.

Quality code	Code	Reason
Telemetry Failure (RTU Link)	T	Telemetry has failed
Manual Replaced	M	Manual updation
Delete from Scan (RTU/point)	D	User disabled the scan of the of data/point
Questionable data	Q	Analog values of the de-energized elements
Calculated	C	Calculated data
Estimated	E	Estimated data from state estimator
Limit Override	L	Limits are overridden
Primary /secondary source	P/S	Primary or secondary source
Reasonability Limit Exceeded	R	Value beyond reasonability limit
Alarm Inhibit	A	Alarm processing is inhibted
Test or maintenance mode	X	Point is in test /maintenance mode

Continuous Real-time data storage and playback:

All real-time data (Analog and status) shall be continuously stored in auxiliary memory for atleast two weeks as and when it is received in the SCADA database from the RTUs.

It shall be possible to playback above stored data on single line diagram and network diagram for a time window of at least 10 minutes (configurable in seconds /minutes) by defining Start and End date and time. It shall be possible to have tabular and graphical trends of the stored data. It shall be possible to set a different sampling rate for playback than the sampling rate for data storage. The users shall be able to select the time window of interest for archival of data in the ISR system for future retrieval

and playback in SCADA system. This archived data shall be transferable in RDBMS database tables of ISR system for generation of tabular displays and reports.

F.8.12. Sequence-of-Events data:

Sequence-of-events (SOE) data shall be chronological listings of 'status change events with time stamp' acquired from RTUs /FRTUs/FPIs. The SOE data shall be collected from all RTUs/FRTU/FPI either in normal polling or periodically/on demand . SOE data collection shall have lower priority than supervisory control actions and normal data acquisition. The SOE data collected from different RTUs/FRTU/FPI shall be merged for chronological listings and stored for subsequent review. Atleast latest 1000 SOE data shall be available for display. The SOE resolution of RTU/FRTU is defined in respective sections for RTU/FRTU. SCADA/DMS system at control centre shall have 1ms SOE resolution. However, as SOE time stamping is done at RTU/FRTU/FPI level , the same shall be in line with resolution defined for RTU/FRTU/FPI. All SOE data collected from all RTU/ FRTU/FPIs shall be stored in daily RDBMS database of ISR system.

a. SCADA language:
   The SCADA system shall have capability to write various programs using IEC 61131-3 SCADA language or C/C++ or any non proprietary language . It will facilitate user (programmer) to write various programs/ logics using points defined in the database.

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

   Supervisory control shall allow the SCADA system to remotely control switching devices. A control action shall require a confirmation-of-selection-prior-to-execution response. Initiation of the control execute step shall occur after the dispatcher confirms that the correct point and control action have been selected.

   After the dispatcher/DMS function initiates control execution, the RTU/FRTU shall be addressed for verification that the correct point has been selected at the RTU/FRTU and then the control action shall be executed. It shall also be possible to reset the flag in FPI through a command. It shall be possible to issue control commands as a group control from SCADA where switching devices pertaining to different RTUs/FRTU or a RTU/FRTU may be controlled as a group. The SCADA system shall send the control commands sequentially (without dispatcher intervention), if the commands pertain to switching devices in the same RTU/FRTU, using the Selection Check before operate (SCBO) of prior–to-execution. The control commands pertaining to different RTUs /FRTUs may be executed in parallel.

   If, after selecting a point, the user does not execute the control action within a programmer-adjustable time-out period, or if the user performs any action other than completing the control action, the selection shall be cancelled and the user be informed. If the communication to the RTU /FRTU is not available, the control command shall be rejected and shall not remain in queue.

   The user shall not be prevented from requesting other displays, performing a different supervisory control action, or performing any other user interface operation while the SCADA/DMS system waits for a report-back on previously executed control actions. The system shall process supervisory control commands with a higher priority than requests for data from the RTU /FRTU /FPI data acquisition function.

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

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

F.8.13. Digital Status Control:

A digital control output results in the activation of an output relay in a RTU. Different commands shall be possible for these digital status controls.

Successful completion of the control request shall be recorded as an event. Failures to complete shall be handled as specified in UI section. Control requests shall be cancelled and the selection of the point shall be terminated when the user cancels a request, does not perform the next step of the control procedure within the selection time-out period from the previous step of the procedure, or the request is rejected.
Breakers:

The user shall be able to select and operate the two state controllable switching device i.e. Circuit breakers/ isolators (in case of RMUs).

F.8.14. Capacitor Banks:

The user shall be able to control capacitor devices. The procedure for controlling these devices shall be the same as that of a switching device except that any supervisory control action must be inhibited for a programmer-adjustable time period after the capacitor/ reactor device has been operated. A message shall appear if an attempt is made to operate the device prior to expiration of that time period & dispatcher is required to give command after expiration of inhibited time period.
Tap Changing Transformers:

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

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

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

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

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

The RAISE and LOWER pushbuttons shall be displayed.

The command shall be launched as soon as RAISE or LOWER is selected.

The Raise and Lower buttons shall not be replaced by a single Execute button. The RAISE/LOWER pushbuttons shall continue to be displayed, and it shall be possible to initiate these controls repeatedly without reselection of the controlled point, provided that the execution of the previous control command has successfully been completed.

The RAISE/LOWER pushbuttons shall remain available until either (a) the dispatcher clicks the CANCEL button or (b) the control times out due to inaction by the dispatcher.

A separate timeout period, adjustable in the range of upto 120 seconds, shall be provided for incremental control. The timer shall be reset and start counting again whenever a RAISE or LOWER command is issued.

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

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

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

F.8.15. Time delayed

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

After executing a supervisory control action, the SCADA/DMS shall pause to obtain an indication of a successful control completion check . If the control completion check is not received, or does not have the expected value, the SCADA/DMS shall terminate the execution of the sequence and shall declare an alarm. Apart from waiting for control completion checks, and unless there is an explicit command for a delay, such as a “Pause” or “Stop” command, the SCADA/DMS shall not introduce any other

delays in the execution of an sequence. No limit shall be placed on the number of Auto execution sequences, which may execute in parallel.

At any time during the execution of a list, the user shall be able to stop further execution via a cancel feature.

F.8.16. Control Inhibit Tag:

A user shall be able to inhibit or enable supervisory control on any device. A tag symbol indicating the control inhibit conditions shall be displayed next to the device on all displays where the device is presented.

The programmer shall be able to define up to 4 tag types with the following attributes for each:

a. Type of controls that shall be inhibited by the tag (e.g., open only (Green tag) close only (Yellow tag), open and close (Red tag), or information only - no control inhibit (White tag). Tags shall be preferably identified by colours. However, distinct symbols /shapes after approval from employer may also be used.
b. Tag priority

Further the user shall be able to place atleast 4 tags per device. Only the highest priority tag shall be displayed. Any combination of tags shall be supported, including multiple tags of the same type. The combined effect of multiple tags shall be to inhibit a type of control if it is inhibited by any of the tags.

When a tag is placed on a device, the user shall be prompted to enter tag number and comment. An event message shall be generated each time a control inhibit tag is placed or removed with information on user ID, type of tag, time of placement or removal of tags.

F.8.17. Control Permissive interlocks:

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

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

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

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

   If the control was successful, an event message shall be generated. For commands issued as part of a group control, DMS applications etc., the successful completion of all device control actions shall be reported via a single message. If the operation is unsuccessful, the user shall be informed of those devices in the group that failed to operate.

F.8.18. Fail-soft capability:

The SCADA system shall be able to manage & prevent system from total shutdown / crash etc in the event of system crosses mark of peak loading requirements through graceful de-gradation of non – critical functions & also relaxing periodicity / update rate of display refresh & critical functions by 50%.

F.8.19. Remote database downloading, diagnostics & configuration:

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

F.8.20. CIM & IEC61850, SMART GRID interface, requirements:

The system shall utilize an IEC 61968 and IEC 61970 compliant interface. The system shall enable export of all data via a CIM-XML interface and shall utilize modelling from IEC 61968 as appropriate. The profiles supported should be CDPSM (Common Distribution Power System Model) and CPSM (Common Power System Model). Messaging interfaces shall be based on model neutral interfaces based on the IEC 61970-40X series for access to real-time and historical data and use the IEC 61968-3 and IEC 61968-9 standards for messaging interfaces that are model dependent for network operations and metering respectively.

Further the above Interfaces shall be used for Integrating with the R-APDRP IT Systems being deployed for real-time & historical data exchange to and from the SCADA/DMS & IT Systems. The IT Systems Interface & the SCADA/DMS Systems Interface shall be so provided using CIM/XML & IEC 61970/61968 standards such that, a 3rd Party application service provider can integrate the two systems or add a 3rd IT or SCADA/DMS System easily, without having to know specific Database Tables / Information of the other system.

Any Change in the electrical network system which will be captured in GIS database of the OPTCL shall be automatically added/modified to SCADA system. E.g.: A new asset addition should be able to be exchanged through Model Information between the IT System, and SCADA/DMS System without programming or configuration effort automatically & adjust and accept the Model and re-configure its databases and should provide updated results. SCADA/DMS Vendors shall provide CIM/XML Adapters for ICCP, OPC or ODBC for their System and CIM/XML Model repository for data and model exchange with IT Systems. Further, system shall be able to interface with IEC61850 (GOOSE & GSSE Models) & provide an Independent 3rd Party modelling tool that can support multiple vendor IEC 61850 IED's and create IEC 61850 SCD files.

To enable to Migrate to Smart Grid, the SCADA/DMS-OMS Systems shall support the following:

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

Refer to the cyber security section of the RFP for additional details

F.8.21. Information Storage and Retrieval:

Information Storage and Retrieval (ISR) function shall allow collection of data from real-time SCADA/DMS system and storing it periodically in a Relational database management system (RDBMS) database as historical information (HI) data. This includes storing of data such as SOE, status data,

Analog values, calculated values, Energy values etc. Programmer shall also be able to set storage mode as by exception in place of periodic storage.

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

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

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

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

It shall be possible to reload any IS&R archival media that has been removed from IS&R and access the archived data without disturbing the collection, storage, and retrieval of IS&R data in real-time.

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

The System Design Parameters of ISR system is given in the section 8

F.8.22. Circuit breaker status Table:

The ISR function shall maintain a table in RDBMS database where real-time status of all Circuit breakers, in case of RMU isolators also along with the associated quality codes shall be stored. The change of status of any breaker shall be updated in this table as soon as the change is detected by the SCADA system. This table shall contain additional information such as date & time of tripping, cause of tripping, Expected duration of outage etc. Some of the causes of tripping could be Supervisory control by user, Protection tripping, Tripping / closing by DMS applications. Information on expected duration of outage shall be taken from schedules for DMS application such as Load shed application etc.

For expected duration of outages due to protection tripping, the same shall be user enterable field. Such daily tables for two months duration shall be stored on auxiliary memory. Tables for the previous day shall be backed up to auxiliary storageby the user at 10AM daily.

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

F.8.23. Real-time Database Snapshot Tables:

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

All Telemetered analog values and Calculated values for all tele-metered analog points (atleast maxima & minima with associated time and average values). Energy values are not envisaged for storage in Data snapshot tables.

All status values with time stamp

All the above values as specified above in (a) & (b) shall be stored along with their associated quality code. The periodicity of the snapshot shall be user adjustable to include 5, 15, 30, and 60 minutes. Data Snapshot tables shall be created on daily basis. Such daily tables for two months duration shall be stored on auxiliary memory. Tables for the previous day shall be backed up to Magnetic tape/ MO/other permanent storage disk by the user at 10AM of every day. The ISR function shall prompt the user through a pop-up window to inform the user for taking the backup. The pop-up window shall persist till user acknowledges the same. In addition to that data can be stored on offline storage device.

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

F.8.24. Hourly Data tables:

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

a. Selected analog values along with their associated quality codes
b. Selected status values along with their associated quality codes
c. Results of hourly calculations for selected analog points (atleast maxima & minima with associated time and average) along with their associated quality codes.

In addition to above a separate hourly energy data table exclusively for energy values (Export and Import Active and reactive Energy values for each feeder) shall be created in ISR along with their associated quality codes.

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

a. Missed Hourly Data Storage:
The programmer shall be able to independently assign any one of the following processing for each hourly value to be executed when the value is missed and cannot be acquired prior to the storage of hourly values.
   i. Store zero and a telemetry failure quality code for each missed hour.
   ii. Store the last good data value, with a questionable data quality code, for each missed hour.
   iii. Temporarily store zero with a telemetry failure code for each missed hour. When the next good hourly value is obtained, divide that value by the number of hours since the last good value was obtained and insert this value, with a questionable data quality code, for all hours with missed data and the first hour that good data was obtained as is the case for energy values.

b. Hourly Data Calculations:
The programmer shall be able to define calculated values using stored hourly data and constants as operands. The calculations shall allow the carry-forward of data from one day, week, or month to the next. The results of all calculations shall include quality codes derived from the quality codes of the operands. The following calculations shall be provided:
   i. Addition, subtraction, multiplication, and division
   ii. Summation of an hourly value by day, week, and month: The running total of the summation for the current day, week, and month shall be updated each hour and made available for display.
   iii. Maximum and minimum of a value over a programmer-definable time period, and the time the maximum or minimum occurred
   iv. Average of a value over a programmer-definable time period.

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

F.8.25. Load priority table:

ISR system shall maintain a Load priority table containing information such as breaker name, number of consumers connected to each Breaker and Load priority of each Breaker.

This table shall be updated by the Billing system in Data centre. Under R-APDRP IT implementation/ legacy master billing centre. SCADA /DMS -OMS control centre operator can also assign priorities in load priority table & the priorities assigned by the Billing system in Data centre & DR Under R-APDRP IT implementation/ legacy billing system may be accepted/ rejected by him. There shall be suitable alarm/event message including user ID for such activity. The table information shall be used by various DMS applications.

a. SOE data table:
ISR system shall maintain SOE data table which shall store the SOE data for complete distribution system. It shall be possible to sort the table by Time, Date, Substation name feeder/line name, device name etc. using SQL commands. This table shall be made on daily basis. Such daily tables for two months duration shall be stored on auxiliary memory. For the purpose of sizing of table,

daily 4 changes per SOE point may be considered. All CBs, protection and alarm contacts shall be considered as SOE. Tables for the previous day shall be backed up to Magnetic tape/ MO disks/other permanent storage media by the user at 10AM of every day.

F.8.26. Data exchange with billing system (Data centre & DR centre)

Under R-APDRP IT implementation:

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

F.8.27. Data Exchange with Customer Care System under R-APDRP IT implementation:

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

F.8.28. Data Exchange with GIS system:

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

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

Data exchange shall be over model neutral messaging services and CIM/XML data exchange for real-time or RDBMS will be used. The following standards as applicable will be used to achieve the above requirements:

a. Messaging interfaces shall be based on model neutral interfaces based on the IEC 61970-40X series for access to real-time and historical data and use the IEC 61968-3 and IEC 61968-9 standards for messaging interfaces that are model dependent for network operations and metering respectively
b. The Graphic data import from GIS systems shall support native formats of GIS systems which shall be potentially used for data import. All Technological addresses (TAs) shall be automatically assigned within the system to the tags linking the graphic data to the attribute data in the GIS, the attribute data shall be loaded into the SCADA data base and the display diagrams shall be generated. The Graphics exchange between GIS and SCADA should happen over IEC-61970-453 Scalar Vector Graphic based XML representation
c. The complete network model including data of electrical network e.g. line (i.e. length, type of conductor, technical particular of conductor & transformer etc, land-base data . Suitable GIS interface adaptor to enable the compatibility with GIS software/ data format /model shall be

provided. The Graphic data import from GIS systems shall support native formats of GIS systems which shall be potentially used for data import. The data shall be transferred on global & incremental basis on manual request & automatically, once in a day. The DMS shall automatically move elements that overlap one another in congested areas so that the operator can clearly see each segment of the network in the geographic view. In addition, the system shall automatically move and scale annotation text that come from GIS so that it is visible the user's current display SCADA/DMS in the geographic view.

d. The system shall include tools to edit annotations /text & symbology placements in geo – referenced displays , substation and distribution network. It shall be possible to import related reference layers such as streets , buildings, poles etc and other background information. All Technological addresses (TAs) shall be automatically assigned within the system to the tags linking the graphic data to the attribute data in the GIS, the attribute data shall be loaded into the SCADA /DMS data base and the data /text shall be displayed on SCADA/DMS diagrams if viewed in GIS mode shall display GIS in background with zoom,pan , scaling & UI navigation techniques in synch with SCADA/DMS system displays. The GIS Network Model shall be exposed to the IT and SCADA Systems over CIM/XML Models using GID to IEC 61968-1 Enterprise Bus.
e. This model repository will be the single model authority for the project to be used by both IT & SCADA/DMS Systems. This repository is maintained by the GIS System, and will be used by SCADA/DMS & other IT Systems for getting network information, customer and interconnection information.

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

g. System Message Log Storage and Retrieval:
System message log, which shall consist of the chronological listing of the SCADA/DMS computer system alarm messages, event messages and user messages shall be stored for archival and analysis. Each entry shall consist of time tag and a text containing user and device identification as displayed on the Alarm Summary or Event Summary displays. The System message log data storage shall be sized for up to 20,000 entries per month.

System message log data shall be stored in daily tables & shall be available for minimum two months on auxiliary memory. System message log data for previous months shall be backed up on Magnetic tapes/ MO disks by the user for which ISR function shall prompt the user every hour with suitable message to remind user for taking the backup on the 10th of every month. This message shall be disabled once the backup is taken. Facilities to sort and selectively display and print the contents of the system message log shall be provided. The user shall be able to select the display of system message log entries based upon Alarm type, Events; User generated messages, Device, and Time period.

F.8.29. Mass storage of data/files:

The ISR system shall be sized for mass storage of data/files for at least the following :

a. 10 save-cases for each DMS application
b. 10 Output results of each DMS applications
c. Data recovery function (DR):

The data related to network model of SCADA/DMS-OMS control centre shall be sent to DR centre periodically once a day & upon user request. The data shall be configured to be sent globally & incremental.. All logs, data model etc & necessary interfaces that are essential for complete system build up shall be stored at DR centre. All requisite data which is building the system from scratch shall be transferred to DR. An alarm shall be generated & sent to SCADA/DMS-OMS control centre upon attaining user defined threshold e.g. 80% for storage at DR centre. The SIA shall provide the DR system and associated hardware and software at a location specified by the Purchaser. The SIA shall ensure 24/7 access to the DR system and in case of need of system restoration for what-ever reason, shall ensure the complete data recovery of the system from the DR system

F.9 DMS FUNCTIONS

F.9.1. General Requirements

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

F.9.2. DMS functions

a. Network Connectivity Analysis (NCA)
b. State Estimation (SE)
c. Load Flow Application (LFA)
d. Voltage VAR control (VVC)
e. Load Shed Application (LSA)
f. Fault Management and System Restoration (FMSR)
g. Loss Minimization via Feeder Reconfiguration (LMFR)
h. Load Balancing via Feeder Reconfiguration (LBFR)
i. Operation Monitor (OM)
j. Distribution Load forecasting (DLF)

F.9.3. Other Supporting functions

Dispatcher training Simulator (DTS)

F.9.4. Contractor's Standard product

The bidders are encouraged to supply standard, unmodified products that meet or exceed the Specification requirements. These products may be provided from the bidder's in-house baseline offerings as standard products from other established suppliers. Bidders shall describe all standard; unmodified products proposed and shall highlight those features that exceed the Specification requirements. Although the bidder is encouraged to use as much standard hardware and software as possible, the proposal will be judged by its conformance to the Specification. Hence, a minimum level of customisation in order functional requirement is permitted. The product CIM based interfaces to other enterprise applications shall be available & compliant of SMART GRID as specified in chapter 1.

F.9.5. Graphical & Tabular display requirements for DMS functions

A network overview display of the distribution system with substations, feeders colour coded by voltage shall be provided. This display shall present the distribution system in a graphic format. Telemetered and calculated values like active and reactive power flows etc. shall be displayed with direction arrow. Lines, Loads, transformers etc that have exceeded their loading limits shall be highlighted. Stations shall be depicted by suitable symbols which reflect the presence of alarms. Cursor selection of a station symbol shall result in display of the associated Single line diagram for that station. " What if "analysis shall be included to visualise network & verify the impact before an action is taken by dispatcher. For all switching actions which dispatcher have to execute manually/step by step shall have the option to simulate switching operations in order to visualise the effect on the distribution network using what if analysis

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

i. Remote controllable circuit breaker with capability to interrupt fault currents
ii. Non-remote controllable circuit breaker with capability to interrupt fault currents
iii. Remote controllable circuit breaker with no capability to interrupt fault currents
iv. Non-remote controllable circuit breaker with no capability to interrupt fault currents
v. Remote controllable disconnector
vi. Non remote controllable disconnector.
vii. Fuse
viii. Ground/ Earth switch etc.
ix. Sectionizer
x. Auto-recloser
xi. The purchaser may ask the SIA to include other elements/components, to the above list, which are a part of the project

F.9.6. Network Model

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

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

r. Fault detectors
s. IEDs
t. Operational limits for components such as lines, transformers, and switching devices
u. Auto-reclosers

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

SCADA/DMS-OMS system shall support for modelling, monitoring, and management of renewable and distributed generation as well as other Distributed Energy Resources

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

The extraction process should comply with the international standard CIM data descriptions. The CIM standard is maintained by the IEC (Technical Committee 57, Working Group 14) and is used for a wide range of purposes. The extraction process should be independent of the real-time network management system. Any GIS model should be extractable to build the network model regardless of the supplier or internal schema.

The extraction should also allow incremental updates & global transfer with no need to bring the system down or even fail over. The model should support extraction on a per-station basis and must be fully scalable from a single zone substation to the largest distribution networks. SCADA/ DMS should be able to present geospatial data even when the link to the source GIS at the data center/DR is not available.

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

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

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

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

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

The required functionalities for this interface shall cover the two following aspects:

a. The transfer of specific real-time data from the DMS into the GIS data-base
b. The possibility to navigate easily from one system to the other through the user's interface
c. Data exchanges shall be made through the Control Center LAN/WAN.. Bidder shall demonstrate its incorporation capability to the main GIS Vendors through a dedicated reference list or provide and support standard interfaces to GIS. Details of demonstration testing are outlined in Vol.1

F.9.7. Network Connectivity Analysis (NCA)

The network connectivity analysis function shall provide the connectivity between various network elements. The prevailing network topology shall be determined from the status of all the switching devices such as circuit breaker, isolators etc that affect the topology of the network modelled.

NCA shall run in real time as well as in study mode. Real-time mode of operation shall use data acquired by SCADA. Study mode of operation will use either a snapshot of the real-time data or save cases.

NCA shall run in real time on event-driven basis. In study mode the NCA shall run on operator demand.

The topology shall be based on

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

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

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

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

A loop refers to a network connectivity situation in which there exist alternative power flow paths to a load from a single power source. A parallel refers to a topological structure in which a load is fed from more than one power source. Parallel paths often result in circulating currents and such operating conditions need to be avoided. All loops/parallels in an electrical network shall be shown by different colours in such a way that each is easily identifiable. Abnormal state of CB/Isolators means these devices are not in their Normal OPEN or CLOSED position.

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

F.9.8. Tracing

NCA function shall also have the capabilities of network tracing when requested by the dispatcher. Dedicated colours shall be used for feeder and circuit tracing and also when information available is not complete or inconsistent.. The trace shall persist through subsequent display call-ups, until the

operator explicitly removes it or requests another trace.In addition, at the bottom of the geographic view the number of transformers and customers passed by the trace are shown.

a. Feeder tracing - This feature shall aid dispatcher to identify the path from a source to all connected components by same colour.

b. Circuit tracing- This feature shall enable operator to select any device and identify the source and path by which it is connected through the same colour.

c. Between Tracings: This feature shall enable the operator to select any two components of the network and shall able to trace all components connected in between them.

d. Downstream Trace – from a selected circuit element the trace identifies all devices that are downstream of the selected element. In the case where a downstream trace is performed on a de-energized section of the network, the trace highlights all devices electrically connected to the element.

F.9.9. Temporary Modifications:

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

F.9.10. Cuts:

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

The cut must be given a name or id number for identification, which is displayed as a label on the geographic network view.

It should be possible to select the position of the label relative to the cut symbol.

The position can be altered after the cut has been placed.

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

F.9.11. Jumpers

Jumpers are a means of providing a temporary, switchable connection between two points on the network. The operator should be able to select two points and place the jumper with relevant details. The initial state of the jumper may be set to open or closed. The jumper popup automatically defaults to show the phases available for connection between the two points but other partial or cross-phase connections may be made if required. The popup shall warn the operator about abnormal connections such as not all phases being connected or the nominal voltage being different at the two connection points. Once the jumper has been placed the switch symbol in the centre can be selected and switched open or closed. The topology of the network model is updated accordingly. There is no restriction on the placement of jumpers between lines connected to different feeders or different substations.

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

F.9.12. Temporary Grounds

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

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

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

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

F.9.13. State Estimation

The primary function is to determine network state where SCADA system monitoring is directly envisaged. The State Estimation (SE) shall be used for assessing (estimating) the distribution network state. It shall assess loads of all network nodes, and, consequently, assessment of all other state variables (voltage and current phasors of all buses, sections and transformers, active and reactive power losses in all sections and transformers, etc.).

Firstly, the symmetrical (per phase) and asymmetrical (three-phase) load of all nodes in the radial or weakly meshed MV network, which are not remotely monitored, that is not directly covered by the SCADA System shall be using evaluated Load Calibration . SE represents the basic DMS function, because practically all other DMS Analytical Functions are based on its results. This is the unique function dealing with the unobservable load of the actual network, which is not directly covered by the SCADA System. Function is used for balanced and unbalanced networks.

The function is based on an algorithm specially oriented towards distribution networks, with low redundancy of real time, remotely monitored data, and the deficiency of real time data has to be compensated with historical data.

Beside the parameters of network elements, the real time data consists of:

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

The historical data of the network consists of:
Daily load profiles – current magnitudes and power factors, or active and reactive powers for all load classes (types, for example: industrial, commercial, residential), for all seasons (for example: winter, spring, summer, autumn), for e.g. four types of days (for example: weekday, Saturday, Sunday and holiday).

Peak-loads for all distribution transformers and/or consumers (peak-currents and/or peak powers) and/or monthly electric energy transfers across all distribution transformers (consumers).

SE function shall run in all cases from the range of networks where all historical data are known, but also in networks with no historical data available (based on parameters of the network elements).

Also according to users setting, the SE function shall be able to run:

a. With or without verification of telemetered measurements.
b. With manual or automatically processing unobservable parts of network.
c. With or without fixed measurements.

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

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

The SE algorithm shall consist of the next important steps:

a. Pre-estimation – It shall be based on the historical data of the network: daily load profiles, peak-loads for all distribution transformers and/or consumers, etc. This step shall give pre-estimated states of considered MV networks.

b. Verification of measurements– It shall be obtained from artificially redundancy of measurements (too small number of measurements and notable main number of pseudo measurements obtained from first approximation). This step shall consider two sub-steps: (a) in sighting evidence bad measurements, (b) verification and/or correction all permanent measurements. In this step, incorrect measurements shall be corrected or discarded.

c. Load calibration – The function shall distribute the load to the busbars of the MV network on the basis of the set of verified measurements and historical data. Also, Load calibration shall deal with consumers specified directly through their current/time diagrams i.e. Load curves as well as with consumers with constant consumption. The function shall run even any of these data are not available. It shall be designed in such a way that the quality of results of the function running increases directly with the amount of given data.

d. Load Flow calculation – This shall be the next function in the specification based on the loads assigned in the previous step.

F.9.14. Input/output

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

Main outputs of the function are estimation of:

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

e. Beside those results, output of SE function is tabular report, also. In this report measurement verification results are presented those results are:
f. Pre-estimated and estimated values of measurements.
g. Minimal and maximal expected values of measurement.
h. Quality of each measurement.
i. Deviation measured values from estimated and pre-estimated values.

F.9.15. Load Flow Application (LFA)

The LFA shall utilize information including real-time measurements, manually entered data, and estimated data together with the network model supplied by the topology function, in order to determine the best estimate of the current network state.

The Load Flow Application (LFA) shall determine the operating status of the distribution system including buses and nodes. The LFA shall take the following into consideration:

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

General Characteristics of LF application:

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

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

including graphical representations of system problems. The SCADA/DMS-OMS system shall support unlimited number of study and save cases for future reference and analysis.

F.9.16. Real Time Load Flow Execution:

The Real-Time LF function shall be executed:

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

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

(a) Event Triggered Real Time LF Execution:
The LF function shall be executed by pre-defined events that affect the distribution system. Some of the events the dispatcher may choose for triggers shall include:

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

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

(c) On Demand Real Time LF Execution:
Dispatchers may initiate the real-time LF function at any time through dispatcher command.

(d) Real Time LF Execution initiated by other DMS Applications:
Other DMS functions may initiate the real-time LF function at any time as desired for the execution of the respective functions.

(e) Study Mode Load Flow Execution:
It shall provide dispatchers with estimates of kW, kVAR, kV, Amps, power losses and the other information on the distribution system, but not necessarily reflecting its real-time state. In study mode the application should use the same data model and have direct access of the real time data as necessary. Study mode load flow shall be used to study contingency cases.

It shall be possible to prepare and store at least fifty cases along with the input parameters, network configuration and output results.

The dispatcher shall be able to select the saved Case to be used as a Base case for LF execution and modify the base case. Possible changes, which the dispatcher shall be permitted to make, shall include:

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

iii. The Study Mode shall calculate various values for each feeder and prepare summaries as LF output.

The Load Flow function shall provide real/active and reactive losses on:

i. Station power transformers
ii. Feeders
iii. sections
iv. Distribution circuits including feeder regulators and distribution transformers, as well as the total circuit loss

F.9.17. Load Flow Output:

The following output capability shall be provided:

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

List of limit violations of voltage magnitudes, overloading.

i. Voltage drops
ii. Losses as specified above

F.9.18. Display and Reports

All input and output data shall be viewed through tabular displays and overlay on the one line network diagram. Tabular displays shall consist of voltages, currents (including phase angles), real and reactive powers, real and reactive losses as well as accumulated total and per phase losses for each substation, feeder and project area. All the overloaded lines, busbars, transformers, loads and line shall start flashing or highlighted.

The LF outputs shall be available in the form of reports. The report formats along with its contents shall be decided during detailed engineering.

F.9.19. Alarms

The LFA shall warn the Dispatcher when the current operating limits are exceeded for any element or when lines are de-energized. It shall also warn the Dispatcher when any abnormal operating condition exists.

Alarms generated during Study Mode shall not be treated as real-time alarms but shall be displayed only at Workstation at which the LF application is running in study mode.

F.9.20. Volt –VAR control (VVC)

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

F.9.21. TAP Changer for voltage control

VAR control devices: switchable and fixed type capacitor banks.

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

F.9.22. Modes of operation

The VVC function shall have following modes of reconfiguration process:

a. Auto mode
b. Manual mode

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

F.9.23. Auto mode

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

F.9.24. Manual mode

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

F.9.25. Reports

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

F.9.26. Displays

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

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

F.9.27. Load Shed Application (LSA)

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

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

F.9.28. Basic rules for load shedding & restoration

The load shall be shed or restored on the basis of following basic rules:

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

F.9.29. By 24 Hrs load shed /restore history

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

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

F.9.30. Modes of operation

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

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

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

F.9.31. Manual Load Shed

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

F.9.32. Manual Load Restoration

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

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

The Load shed Application shall maintain a load restore timer, which shall automatically start after tripping of CB due to manual load shedding. An alarm shall be generated to remind the operator to

restore the loads when this timer expires. For manual mode of operation, the dispatcher shall enter the value of load restore timer.

F.9.33. Auto Load Shed

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

(a) Frequency based Load Shed

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

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

(b) Time of day based Load Shed

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

(c) Auto Load Restoration

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

i. Frequency based restoration

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

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

ii. Time of day based restoration

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

F.9.34. Alarms/Events

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

F.9.35. Summary Report

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

Daily Load shed report indicating, substation name, feeder/device name, date/time, duration of load shed and amount of load shed, Number of consumers affected based on consumer indexing information, mode of load shed including planned outages of feeders/network equipments.
Daily Alarm summary pertaining to LSA, substation wise.

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

F.9.36. Fault Management &System Restoration (FMSR) Application

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

F.9.37. Functional Requirement

The FMSR function shall include the following characteristics:

a. FMSR shall be capable of handling phase-to-ground and phase-to-phase faults and shall not be restricted by their time of occurrence on one or more feeders. Thus, the ability to handle multiple faults of different types, on multiple feeders, shall be provided. It shall be capable to carry out restoration of large area after a occurrence wide spread faults amounting to substantial outages in the town.
b. FMSR shall be capable of allowing the substitution of an auxiliary circuit breaker or line recloser that may temporarily function in place of a circuit breaker or line recloser that is undergoing maintenance.
c. The Operator shall be able to suspend FMSR restoration capabilities by activating a single control point. Otherwise, FMSR shall continue to operate for fault detection and isolation purposes. The Operator shall be able to resume FMSR's normal operation by deactivating the same point.
d. FMSR shall be capable of isolating faulty sections of network by opening any available line Circuit Breaker that may be necessary, however operating limitations on device such as control inhibit flag shall be respected.
e. FMSR application shall utilize the results of LF for recommendations of switching steps for restoration where in it should guide the operator for amount of overloading in lines ,bus voltage violations and amount of load that can be restored for various options of restorations ,the operator shall have the privilege of selecting the best restoration option suggested by FMSR before it starts restoration .The operator shall also be to simulate the LF for the recommended switching actions ,so that the necessary violations can be displayed on graphical display also.

f. If an overload condition is expected as a result of the proposed switching, it shall be displayed to the operator on a graphical display and proposed alternative switching sequence to avoid or minimize the overload.
g. FMSR shall be capable of using data derived from substation RTUs/FRTUs /FPIs to recognize faults in substation transformer banks, any fault on the primary side of these banks that cause loss of outgoing feeder voltage and current or any fault occurred on 11KV network.
h. FMSR shall be capable to make Restoration plans with identification name and respective merit orders & its execution of Restoration plan using network Display and single line diagram of substation.
i. FMSR shall be capable to find delay in the restoration of network beyond specified time (Despatcher configurable) and shall be able to report separately in the form of pending restoration actions.

F.9.38. Detection of fault

FMSR function shall detect the faulty condition of the network causing CB tripping due to protection operation or FPI indication. The Circuit breakers having auto-reclose feature, the FMSR application shall wait for programmer specified (settable for individual feeders) duration before declaring the network as faulty. On detection of fault in the network, an alarm shall be generated to draw attention of the dispatcher.

Switching device tripping caused by SCADA/DMS applications shall not be considered as a faulty condition. FMSR application shall also not be initiated if the quality flags such as, manually replaced value and Out of scan are set for a switching device. To avoid potential difficulties during severe storm conditions, the Operator shall be able to suspend FMSR switching sequence of restoration capabilities by activating a single control point. Otherwise, FMSR shall continue to operate for fault detection and isolation purposes. The Operator shall be able to resume FMSR's normal operation by deactivating the storm-mode control point. When this occurs, FMSR shall be ready to restore power as well as detect and isolate faults following the next outage event. The same shall be recorded as an event.

F.9.39. Localisation of Fault:

Wherever protection signal or FPI indication is not available , FMSR function shall determine the faulty section by logically analysing the Telemetered data (status of CBs, , analog values etc) as acquired through SCADA system. Besides this, for such cases an iterative method for determining fault shall be used e.g. In case of fault, upstream breaker is tripped & long stretch of multiple sections are having no intermediate fault indicators & intermediate switches are not capable to trip on fault upto the closest NO(Normal open) point, the dispatcher can open the last switch before NO point & try to close breaker , if trips again fault is on further upstream & the same method is to be repeated else fault is located in the downstream section only. For the sections where protection signal or FPI indication is available , the same shall be derived through these Telemetered signals. Network diagram identifying the faulty sections/components shall be displayed identifying the relevant section. and various configurations of switch type etc) Minimum of following switch types shall be considered by FMSR system:

1: Remote controllable circuit breaker with capability to interrupt fault currents
2: Non-remote controllable circuit breaker with capability to interrupt fault currents
3: Remote controllable circuit breaker with no capability to interrupt fault currents
4: Non-remote controllable circuit breaker with no capability to interrupt fault Currents.
5: Remote controllable disconnector
6: Non remote controllable disconnector.
7: Fuse.
8: Ground/ Earth switch etc

F.9.40. System isolation & restoration

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

The FMSR function shall have following modes of restoration process:

a. Auto mode of restoration
b. Manual mode of restoration

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

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

(b) (b) Manual mode of restoration

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

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

(d) Displays
The User interface for FMSR function shall have following summary displays as minimum:

i. Network & tabular display to identify faulty network
ii. Network & tabular display to identify remotely controllable devices
iii. Network Display to show plan for Isolation of faulty sections from the network using single line diagram of substation or network as selected by the despatcher.
iv. Tabular display for Restoration plans with identification name and respective merit orders & execution of Restoration plan using network Display and single line diagram of substation
v. Delay in the restoration of network beyond specified time (Despatcher configurable) shall be reported separately in the form of pending restoration actions in Tabular display.
vi. List of sections not restored with the reasons for non-restoration such as overloading and voltage limit violations etc shall be shown in tabular display.

F.9.41. Loss Minimization via Feeder Reconfiguration (LMFR)

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

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

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

LMFR application shall run periodically at every 15 minutes and on demand. Short duration Power Interruption to the consumers during suggested switching operations may be permitted.

F.9.42. Modes of operation

The LMFR function shall have following modes of reconfiguration process:

a. Auto mode
b. Manual mode

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

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

b. Manual mode
   In manual mode, the function shall determine switching plans automatically for minimal loss condition in the network based on which despatcher can perform switching operations in step-by-step manner.

   A filter for remote operable & manual switches shall be provided with switching plan ,

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

F.9.43. Load Balancing via Feeder Reconfiguration (LBFR)

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

The Feeder Reconfiguration Function shall be activated either by an overload condition, unequal loadings of the parallel feeders and transformers, periodically or on demand by the despatcher. It shall generate the switching sequence to reconfigure the distribution network for transferring load from some sections to other sections. The LBFR application shall consider the planned & unplanned outages, equipment operating limits, tags placed in the SCADA system while recommending the switching operations.

The function shall distribute the total load of the system among the available transformers and the feeders in proportion to their operating capacities, considering the discreteness of the loads, available switching options between the feeder and permissible intermediate overloads during switching. The despatcher shall have the option to simulate switching operations and visualise the effect on the distribution network by comparisons based on line loadings, voltage profiles, load restored, system losses, number of affected customers.

The function shall have following modes of reconfiguration process:

a. Auto mode
b. Manual mode

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

F.9.44. Auto mode

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

F.9.45. Manual mode

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

Displays & Reports - The summary report shall cover the followings:

i. Loadings of feeders and transformers before and after reconfiguration.
ii. Voltage profile of the feeders before and after reconfiguration.

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

F.9.46. Load Forecast –

a. Short-Term Load Forecasting (STLF):
   Short-Term Load Forecasting (STLF) analytical function will be used for assessment of the sequence of average electrical loads in equal time intervals, from 1 to 7 days ahead.

As noted above, the STLF function shall be based on different forecasting methods such as:

i. Autoregressive.
ii. Least Squares Method
iii. Time Series Method.
iv. Neural Networks.
v. Kalman filter
vi. Weighted Combination of these method

In the first step, training module is executed using load data series from the historical database and weather conditions. After appropriate training, Forecast module is executed for up to next 7 days

including weather forecast. Results are available in tabular and graphical form. The user shall be able to make adjustments to the active forecast. The adjustments can also be done through weather conditional data parameters i.e. temperature, humidity, precipitation level, wind speed, wind direction acquired through Telemetered sensors or manually.

STLF will be used for forecasting of loads for the next short-term period (up to 7 days), to provide planning of the (optimal) network operation at the daily level. in periodic time (15 min to 1hr) The user shall be able to save forecasts in save cases, one of which shall contain the active forecast that shall be available for study functions.

F.9.47. Similar day forecasting

A similar day forecast shall be used that is based on the normalized half-hourly load values stored for each of seven-day types. Provision shall be made for storing day types for the last 24 months. The storage shall be updated each day by replacing the oldest of the same day type with the most current actual load curve.

The similar day forecast shall search the 24-month file for the same day type whose weather conditions best match. It shall then present the user-entered and best-matched conditions, for user comparison, together with the chosen day's loads as the suggested forecast. The user shall be able to modify any of the forecast's loads manually. In addition, the user shall be able to scale the entire forecast by simply specifying an appropriate peak load value.

Multi-day forecasts shall be constructed by permitting the user to define the input data for each forecast day.

The results of the previous forecasts will be compared with the actual load realization. The performed differences will be used for updating the forecasting procedure parameters.

F.9.48. Long Term forecasting

In addition to the above, Long term load forecasting shall also be available for at least 1 year. The same shall be calculated based on the peak load values or energy consumptions on weekly/monthly basis for at least two preceding years, Array of forecasted peak loads imported from STLF/ entered manually.

The user shall be able to print and display the forecasts in both tabular and graphical form. This shall include the ability to display the active forecast with the actual loads of current and past days superimposed, energy consumption/peak load curves in the forecasting period. .

Results of Function

Main input data for the LF will be:

i. Historical Load measurements for specified network points, associated with corresponding weather conditions.
ii. Daily load curves & energy consumption from the past, for all type of days and seasons.
iii. Weather prognosis for the forecasting period.

Main output data of the STLF will be:

i. Forecasted load for the forecasting period

F.9.49. Operation Monitor

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

Each monitored device shall be associated with a total operations counter. This counter shall be incremented whenever the associated device changes state. When a multiple change (such as a trip-close-trip sequence) is reported by an RTU/FRTU, each transition shall be counted separately. In addition, a fault operations counter is required. This counter shall be incremented only for uncommanded trip operations. The date and time of the last operation shall be saved for each device when one of the counters is incremented.
An Operator with proper authorization shall be able to enter a total operations and fault operations limit for each counter. An alarm shall be generated when a counter exceeds its limits. No additional alarms shall be generated if the counter is incremented again before it is reset. For each counter, the System shall calculate the present number of operations expressed as a percent (which may exceed 100%) of the corresponding limit.

The ability to reset individual counters shall be provided. In addition, a user shall be able to inhibit operations counting for individual devices. Such devices shall be included in summaries based on areas of responsibility.

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

F.9.50. Dispatcher Training Simulator (DTS)

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

a. The DTS model shall simulate the distribution power system in a realistic manner, including its response to simulated events, Instructor actions, and Trainee actions. The response shall be identical to the response observed by the dispatcher in the actual computer system environment.

b. The consoles shall be assignable as trainee or instructor consoles. The DTS shall support at least one instructor & two trainees

c. Instructor control features shall include the ability to set up, control, participate in, and review the results of a training session.

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

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

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

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

h. DTS function shall have ability to establish the following training conditions as a minimum:
   i. Normal steady state
   ii. Disturbed network conditions for distribution network
   iii. High & Poor Voltage conditions
   iv. Poor VAR conditions
   v. Indiscriminate tripping
   vi. Islanding
   vii. System blackout
   viii. System restoration
   ix. Conditions/functions included for SCADA/DMS real time system

i. Following features as minimum:
   i. All SCADA/DMS functions as envisaged in the specification
   ii. Cry wolf alarms
   iii. Record/ Playback /slow/real-time/fast forward.
   iv. Record trainee actions

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

F.9.51. Instructor Control:

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

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

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

F.9.52. Trainee control :

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

F.9.53. Pre-Session Activities

The Instructor shall be able to create a base case and to execute a power flow if desired to initialize the base case. The Instructor shall be able to build groups of events scheduled to occur during the

training session. A training session shall be built by combining one or more event groups with a base case.

F.9.54. Scenario Construction

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

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

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

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

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

e. Base Case Editing: shall allow instructor to modify a base case and to store the updated version.

f. Event Group Construction: shall allow instructor to construct event groups containing one or multiple events. The Instructor shall be able to define the events within the event group to occur simultaneously or according to other parameters of time or system conditions. Checks shall be performed to assure that each event entered is one of the predefined set of events and that the equipment and parameters associated with the event are valid for the event specified. The system shall provide an interactive means for specifying the device or point associated with each event.

g. Event Group Store: shall allow the Instructor to save the event group constructed for future use.

h. Event Group Select: shall allow the Instructor to select one or more event groups for incorporation into a training scenario.

i. Event Group Review: shall allow the Instructor to display events within an event group.

j. Event Group Editing: shall allow the Instructor to modify an existing event group and to store the updated version.

F.9.55. Event Types

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

a. Change of bus load
b. Change of system load
c. Fault application/FPI indication
d. Circuit breaker trip/close
e. Circuit breaker trip with successful reclosure

f. Circuit breaker trip with unsuccessful reclosure
g. Isolators switchings
h. Supervisory control disable/enable for specific device
i. Relay status enable/disable
j. Loss of RTU /FRTU due to telemetry failure for specified period of time
k. Loss of single RTU /FRTU point
l. Replace value of telemetered point
m. Messages to Instructor
n. Pause simulation
o. Demand snapshot.
p. Cry wolf alarms

F.9.56. Event Initiation

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

a. Time Dependent Events: These events shall be scheduled by the Instructor to occur at a specified simulated clock time or at time intervals relative to the start time of the scenario.

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

c. Demand Events: The Instructor shall be able to demand the immediate execution of an event without having to insert it in the events list.

d. Relay Initiated: The operation of a relay shall result in the execution of one or more Instructor-specified events.

F.9.57. Session Activities

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

a. Pause/Resume: Shall allow the Instructor to suspend or resume the training scenario without affecting the scenario. While in the Pause mode, the Trainee and Instructor shall be able to call all displays but perform no other functions. The Resume command shall resume the simulation from the point at which the pause occurred.

b. Slow/Fast Forward: shall allow the Instructor to move a training scenario forward at a Instructor-specified speed slower/faster than real-time.

c. Event Insertion: shall allow the Instructor to add new events when a training scenario is in progress without the need to interrupt the training scenario.

d. Event Demand: shall allow the Instructor to demand the immediate execution of an event.

e. Event Omission: shall allow the Instructor to omit a scheduled event from the training scenario in progress without interrupting the training scenario.

f. Periodic Snapshot: shall allow the instructor to create a historical file that is periodically updated with session data necessary to resume simulation as it occurs during the simulation. The DTS shall not pause while the snapshots are being collected and saved. The snapshot save area shall be circular in nature where the oldest snapshot will be overwritten each time a new snapshot is saved when the save area is full.

g. Demand Snapshot: shall allow the Instructor to create a historical file, identical to that created by a periodic snapshot, on demand during the simulation. The DTS shall not pause while the snapshots are being collected and saved.

F.9.58. Post-session Activities

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

a. Snapshot Review: shall initialize the DTS with a snapshot saved during a training session. After a snapshot has been loaded, the Trainee and Instructor shall be able to call displays to examine any data available during a session.

b. Snapshot Resume: shall resume the simulation from a snapshot in the same manner as it would resume from a Pause.

c. Evaluation report : Based on the actions performed , timeliness & an evaluation report shall be created to review performance of trainee.

F.9.59. DTS Performance and Sizing

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

a. 20 DTS base cases
b. 20 scenarios
c. 250 event groups
d. 50 events per group
e. 50 session snapshots
f. 5-minute snapshot periodicity
g. 100 conditional events
h. 1000 variables in conditional events.
i. 2 Trainee (according to no. of DTS consoles) & 1 instructor

F.9.60. DTS Database and Displays

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

In addition to the above specification, Distribution Operator Training Simulator (DOTS) shall have the applications used as the same applications used in the production system, with the same UI, displays, and functionality. System shall include full simulation of the distribution power system that accurately reflects both static and dynamic system characteristics. DOTS should consist of 3 major components:

a. Control Center Functions: System shall consists of all modules typically used in the real -time system (e. g. SCADA, alarm processing, load shedding, trending, etc.)
b. Power System Simulator: System shall provide a simulation of the power system that responds realistically to any scheduled or operator initiated activities. The power system simulator is based on DPF power flow engine and power system dynamic models including dynamic modelling of faults, relays, voltage regulators, capacitor controllers
c. Instructor Interface: System shall enable the instructor to maintain complete control over the training scenario and set up events to occur during simulation; to begin, stop and start the simulation; to respond to trainee-requested actions; to control external areas; and to spontaneously create new events as desired.

F.10 OUTAGE MANAGEMENT SYSTEM

F.10.1. Overview

The following section describes the OMS component of ADMS. The OMS shall be flexible Outage Management System designed to maximize the performance of OPTCL dispatchers by working with a single SCADA/ADMS user interface to help operators and dispatchers better handle system outages.
Main features –

a. Outage Management
b. Outage Analysis & Prediction
c. Crew Management
d. Switch Management
e. Field Scheduling & Dispatching
f. Reports

Implementation of the integrated OMS is intended to provide OPTCL with the following functions:

a. A graphical display of the electric sub-transmission and distribution network with dynamic symbols indicating outages, crews and predicted failure points
b. A predictive engine to identify potential outage devices based on the number, type and location of customer outage calls
c. A management information capability to allow management and executives access to summaries and details of outage status and progress via the intranet
d. A database capable of calculating monthly, year-to-date, and annual industry standard outage statistics using the latest IEEE heuristics or other industry standard
e. A predictive engine to provide information on expected restoration time
f. Crew scheduling and tracking capability to manage crews and field personnel during outages
g. A switch management module that supports the initiation of Power Out requests, schedules Power Out requests, generates suggested switching plans for both a geographical view and an operating schematic view of the networks.
h. A set of geographical views of the facilities that provide both a geographical view and an automated operating schematic view generated of the networks
i. A set of field based tools that facilitates status reporting and outage completion collection.

F.10.2. Outage Management

A key requirement is for the OMS to support a well-defined life-cycle of an outage event and to give the dispatcher visibility at all times as to what state an outage is in and how much time is left to restore the outage.Trouble Call Management shall include No Current Complain, In Service & Streetlight Calls etc.

Compliance Questionnaire

Req. ID	Outage Management	Capability Supported?	Bidder Response
1.1	The system shall support the notion of an outageevent life cycle. Describe your system's supportfor) unacknowledged – new events unacknowledged by any dispatcher yet) acknowledged - looked at/being analyzed by a dispatcher) dispatched - manually or automatically assigned time and confirmed by a crew that is on the way to it		

Req. ID	Outage Management	Capability Supported?	Bidder Response
	) arrived – time crew has arrived at dispatched event) assigned - assigned to specific crew for future work) planned – switch plan related outage event) restored - crew got power back) complete - detailed root cause, failed device, weather conditions, follow-up routine work orders generated, etc…		
1.2	The system shall highlight via blinking and use of colors, all outage events that are in their unacknowledged state.		
1.3	The system shall present to the user the list of outage events associated with his area of control.		
1.4	The user shall be able to sort his list of outage events by any combination of the displayed sets of fields.		
1.5	The user shall be able to select any outage event and see the detailed customer called-in comments entered by the customer service representative associated with the predicted or confirmed event.		
1.6	The user shall be able to push any predicted outage event upstream to the next device.		
1.7	The user shall be able to push any predicted outage event downstream. The system shall generate a new predicted outage for each of the devices (typically lateral fuses) that are immediately downstream from the currently predicted outage device.		
1.8	The user shall be able to dispatch an event to one or more crews.		
1.9	The user shall be able to assign multiple events to a single crew for him to work on in the future.		
1.10	The user shall be able to manually enter in the start time for an outage event. The system shall save all outage events that had their start times manually overridden in a table, identifying the user, time of override, current and overridden values.		
1.11	The user shall be able to add non- grouped calls to an existing event.		
1.12	The user shall be able to create a temporary jumper to capture the current configuration of a circuit as reported by the crews.		
1.13	The user shall be able to add one or more tags to a device. Describe the tagging capabilities of the Proposed OMS system, including the number of tags available, multiple tags on a device etc.		
1.14	The user shall be able to add one or more notes to a device.		
1.15	The user shall be able to raise and remove conditions on a device as they are created and removed in the field to indicate:		

Req. ID	Outage Management	Capability Supported?	Bidder Response
	) grounds exists) a device in local mode) a device in lightning mode) the communication to device has failed) a device in loop scheme) a device in auto reclosing mode		
1.16	The user shall be able to generate a tabular list of all devices that are currently operating in their abnormal state.		
1.17	The system shall display via symbology on all graphical views that a device is located on, its conditions that have been raised either automatically or manually.		
1.18	The system shall automatically refresh all users' displays that contain a device whose status has changed or had an operating condition raised or removed.		
1.19	The system shall automatically refresh all users' displays that contain an event that has just been created or restored.		
1.20	The system shall be able to integrate with a on call crew roster (RDBMS based) and contact crews for acknowledged events that occur after normal operating hours.		
1.21	The system shall automatically indicate an event has been dispatched once the crew has accepted the event.		
1.22	The system shall automatically remind the dispatcher that he hasn't received an acknowledgement back from the crew for a dispatched event, after a user defined period of time, whom he attempted to contact via the radio or was automatically called. This reminder shall be saved by the system in an event logger.		
1.23	The user shall be able to open and close a device by selecting it graphically and performing the operation. Please indicate if the proposed system supports select before operate approach.		
1.24	The user shall be able to enter all outage event details required to complete the outage.		
1.25	The user shall be able to enter appropriate information to generate a follow-up work order for the outage event.		
1.26	The system shall be able to create a work order request based on the previously entered information in the work management system.		
1.27	The system shall track all work orders that were created for an outage event.		
1.28	The user shall be able to generate a tabular list of work orders that were created for an outage event and see their current status information or completion dates.		
1.29	The user shall be able to enter completion details for partial restoration events.		

Req. ID	Outage Management	Capability Supported?	Bidder Response
1.30	The system shall keep track of all partial Restoration events that were part of restoring all customers. Each partial step shall have its own ending time stamp for the set of customers it restored.		
1.31	The user shall be able to list all partial events that belong to an outage event.		
1.32	The user shall be able to list all partial events that belong to an outage event.		
1.33	The system shall be able to generate a list of executives and managers to be used to page, email or phone with the related outage details when a set of Critical customers are affected by either a probable or confirmed outage event.		
1.34	The system shall use line color or symbology or dynamic attribute such as blinking to indicate the current operating state of a section of circuit: - energized - de-energized - grounded - dual sources		
1.35	The system shall use line color or symbology to indicate the number of phases on a section of circuit.		
1.36	The system shall use line color to differentiate circuits. To support this, the system shall use its own color map of at least 256 colors to generate the color to be used for each circuit such that no circuits that could be tied or jumpered together have the same circuit color.		
1.37	The user shall be able to toggle between which of the two types of circuit line colors they want to view: single circuit vs. phase based.		
1.38	The system shall automatically generate its single circuit view and 3-phase schematic backbone view from its topology model each time the topology model is reloaded from the GIS.		
1.39	The system shall accept schematic drawings as input and generate the connectivity to the topology model based on the devices that appear on both the geo-reference view that has already been loaded from the GIS and the new schematic that is being imported.		
1.40	The system shall maintain all device states, tags, notes, conditions, jumpers, crew locations and crew assignments after its topology model has been updated from the GIS.		
1.41	The system shall support an automated restoration verification process. Please describe your system's use of IVR to support an automated verification process. Please describe your system's current or potential use of intelligent field devices to support an automated restoration verification process.		

F.10.3. Outage Analysis & Prediction

The ADMS will provide an analysis engine that processes the trouble call information received from the trouble call entry system, from the IVR system and device state change messages from the SCADA/ADMS system. The outage prediction engine will generate a probable outage event based on the currently defined set of heuristic rules that typically takes into consideration: number of calls received, time between calls, trouble call codes, network topology, currently available crews, currently dispatched crews and type of probable outage device; the outage prediction engine will generate a probable outage event.

Compliance Questionnaire

Req. ID	Outage Analysis & Prediction	Capability Supported?	Bidder Response
2.1	The system shall support incoming calls that have multiple call codes on a single call that indicate whether there may be an outage, there is an emergency situation, there is a need for maintenance or there is a request for service.		
2.2	Please explain how your system groups calls into probable outage events.		
2.3	Please explain what your system does with emergency call types.		
2.4	Please explain what your system does with non-emergency and non-outage requests for maintenance or service.		
2.5	The system shall provide a configuration mechanism for authorized non-programmers to change the prediction and grouping behavior of the system.		
2.6	The authorized user shall be able to name and save his changes to the configuration of the outage prediction engine to a catalog of configuration.		
2.7	The system shall support a catalog of named configurations that can be loaded and put into production during special storm conditions. Describe in detail what happens to your call processing engine and interfaces with SCADA /ADMS and IVR systems during the cut over to a new heuristic set of rules to be used for the outage prediction engine.		
2.8	The system shall support call types that indicate a service or premise level outage and it will not try to roll these types of events into events upstream, nor will the system try to group and close these events when upstream events are restored and completed. Please describe in detail your system's native support for this service level and other nested device outages.		
2.9	The system shall support momentary outages and provide for automatically grouping of call types such as lights flickering to a momentary outage event.		

Req. ID	Outage Analysis & Prediction	Capability Supported?	Bidder Response
2.10	The system shall support automatic notification of confirmed or real outages via an automated interface with a SCADA system and automatically group all future related calls to the outage event.		
2.11	The system shall assign an estimated restoration time based on device type, number of active outage events, and number of active crews.		
2.12	The system shall assign a start time to the outage event based on the earliest of the first call associated with the event, or the automated interface message that raised the event.		
2.13	The system shall support multiple voltage classes in its topology model used to predict outage events: Sub-transmission Voltages Distribution Voltages		
2.14	The system shall use the transmission substation breaker as its source for sub-transmission category outages and trace to source functionality.		
2.15	The system shall use the distribution substation breakers as its source for distribution category outages and trace to source functionality.		
2.16	The system shall use the DMS/SCADA monitored device information to keep predicted outages from rolling up to the set of DMS/SCADA monitored devices based on trouble calls processed.		
2.17	Describe the system's algorithm(s) for breaking up outage prediction zones across sub-transmission and Distribution voltages. Assume connectivity exists in the topology model through the distribution substation.		
2.18	Describe the system's behavior for generating outage prediction events when receiving calls that are being served by a network grid configuration.		
2.19	Describe the system's behavior when receiving a trouble call or emergency call when it can't logically group or assign to a Device or existing outage event.		
2.20	The system shall include an automated process to create and replay outage calls to simulate single outages, small storms, and major storms for training purposes. The process shall include a mechanism to capture and re-create real storms events including replaying ADMS messages in time sequence.		
2.21	Please describe your analysis engine's current use of AMR /AMI information and your support capabilities for intelligent field devices.		

F.10.4. Crew Management

a. The ADMS shall be able to create tickets, manage tickets, and operator dispatching of crew(s) for assignment to outages, including outage definition, number of crew members, type of crew, and equipment information.

b. The ADMS provides the user the ability to assign outages to one or more crews simultaneously and/or sequentially. The ADMS provides the ability for the user to indicate that a crew is at the work site.

c. The ADMS shall be a GUI based Crew Management module that has functionality to manage crews, allocate/re-allocate resources, track contact information and their history of all previous calls and whether they were reached, whether they came in, or declined when called.

d. The ADMS crew functionality tracks crew hours worked and monitors and alarms when crews are about to exceed their workload requirements.

e. The ADMS crew functionality can indicate the type of vehicle associated with the crew.

f. The ADMS user can create new crews using the crew administrative tools, to define as permanent or temporary; and the new crews are immediately available in the system.

g. The ADMS shall have ability to call out a crew when no crew is available by providing Crew Callout functionality.

h. ADMS shall have ability to calculate the number of crew recommended to achieve a system-wide estimated restoration time.

i. Compliance Questionnaire

Req. ID	Crew Management	Capability Supported?	Bidder Response
3.1	The user shall be able to define preconfigured crews. The crews are made up of crew members, trucks and special equipment.		
3.2	The user shall be able to mark a crew as active or inactive.		
3.3	For each individual crew member, the system shall contain his contact information: ⎫ pager number ⎫ cell number ⎫ radio number ⎫ truck id ⎫ emergency contact number		
3.4	The user shall be able to quickly create new crews containing contractors and make them active so they can have events dispatched or assigned to them.		
3.5	The user shall be able to quickly split or merge crews based on crew restrictions or outage event conditions.		
3.5	The system shall track hours on the job for each individual Crew member.		

Req. ID	Crew Management	Capability Supported?	Bidder Response
3.6	The system shall generate an alarm that color codes the crew on both the graphical and tabular displays they are displayed on when any member of the crew has reached a user definable threshold of hours on the job.		
3.7	This system shall alarm the dispatcher when a crew member is overdue for a meal or rest period.		
3.8	The user shall be able to generate a list of crew members that have reached a threshold number of hours on the job.		
3.9	The user shall be able to list for each crew, its members and the hours (and partial hours to the tenth of an hour) currently on the job for each crew member and all events that have either been dispatched or assigned to the crew.		
3.10	The user shall be able to view the list of available crews.		
3.11	The user shall be able to view list of crews that have been dispatched to trouble events in the field.		
3.12	The user shall be able to view the list of crews who have no trouble events dispatched or assigned to them.		
3.13	The system shall generate and display for each crew the estimated time they have left on the trouble events that have been dispatched or assigned to them.		
3.14	The system shall be able to generate the number of additional crews required based on the current set of known and predicted outages and the number of active crews, their remaining availability and the user entered desired outage completion time.		
3.15	The system shall provide remote access (via a secure Web based application) for all of its crew management functionality.		

F.10.5. Switch Management

The ADMS shall have the ability to have temporary network conditions applied such as jumpers, grounds, cuts, etc. A separate list of these network changes shall be maintained and easily accessible to the operator.

Compliance Questionnaire

Req. ID	Switch Management	Capability Supported?	Bidder Response
4.1	The system shall support a catalog of switching templates.		
4.2	The system shall maintain an archive of switching orders for 3 years.		
4.3	The system shall pre-fill in the switching header from the details it receives from a work order.		

Req. ID	Switch Management	Capability Supported?	Bidder Response
4.4	The user shall be able to select a group of devices or sections of circuit and have the system automatically generate a suggested switching order to isolate the selection based on load flow analysis, minimum number of switching steps and the current network configuration.		
4..5	The user shall be able to query the catalog of switching templates and instantiate his current Power Out request based on the selected template.		
10.4.5.6	The user shall be able to manually select and operate devices and the system shall record the steps into a switching order.		
4.7	The system shall support an import mechanism to load existing switching templates and historical switching orders from a RDBMS.		
4.8	The user shall be able to go into a planning mode that doesn't affect any of the outage management users to generate his proposed switching orders and to verify them by playing them forward against a copy of the current network configuration.		
4.9	The user shall be able to add safety and operational steps at the appropriate locations in the switching order. The user shall also have the capability to insert additional instructions, checks or otherwise edit the system generated step.		
4.10	The user shall be able to group multiple work orders and manually entered Power Out requests and generate a single switching order for that set of work orders.		
4.11	The system shall track all work orders supported by a switching order.		
4.12	The user shall be able to create multiple switching orders for a single work order or Power Out request.		
4.13	The switching order shall be printable, faxable, and be able to be sent electronically to crews in the field.		
4.14	The user shall be able to generate a list of affected customers for each planned outage and use the list to generate door hangers, mailers and phone calls.		
4.15	The user shall be able to generate additional switching orders based on switching orders that have been saved.		
4.16	The system will provide assistance to the user once he has indicated the start of a planned switching order has been executed in the field. It will timestamp the switching steps as the dispatcher acknowledges them. It will keep the active step highlighted within the switching order for the dispatcher.		

Req. ID	Switch Management	Capability Supported?	Bidder Response
4.17	The system will provide assistance during the planning of Power Out requests by displaying a list of existing planned switching orders that affect overlapping facilities with the Power Out request's isolation area during an user definable window of time (within next 2 days, week, 2 weeks, etc…)		
4.18	The system will provide signature review cycles for planned switching orders.		
4.19	The system will notify the work management system when all necessary switching orders have been created for a work order/Power Out request.		
4.20	The user will be able to adjust the steps within a switching order after it has been started. To support this, the system shall support alphanumeric numbering of switching steps within a switching order.		
4.21	The system shall have a module for users to manually enter Power Out requests as well as supporting the interface with a WMS to accept Power Out requests from an external system.		
4.22	The system shall support GUI based management screens for users to display, sort, and group Power Out requests.		
4.23	The system shall provide management reports about the status of Power Out requests.		
4.24	The system shall provide graphical scheduling aids of Power Out requests that support detection of network based overlaps and conflict detection between Power Out requests.		

F.10.6. Field Scheduling & Dispatching

The necessary interface mechanism to send both pre-assigned trouble work and unassigned trouble work to a scheduling module is part of this project., we are asking to Bidders who have such scheduling modules to answer the following set of requirements.

Compliance Questionnaire

Req. ID	Field Management	Capability Supported?	Bidder Response
5.1	The system shall automatically generate a schedule to be used by either the auto dispatching module or a human dispatcher. It will be based on the trouble call codes, the location of the predicted device and the location and skill types of the crews that are active.		
5.2	The system shall accept pre-scheduled requests, that is, events already manually assigned to a specific crew by the dispatcher.		
5.3	The system shall accept cancellation requests for all work order types. Describe the system's behavior		

Req. ID	Field Management	Capability Supported?	Bidder Response
	when the cancellation request arrives after the work order has been scheduled and dispatched to the field.		
5.4	The system shall generate new estimated restored times for all events that have been extended beyond their original estimated restore time because of the lack of resources to dispatch to.		
5.5	The system shall accept multiple work order types to be scheduled: - service (turn on, shut off, meter checks) - maintenance & inspection trouble - emergency - construction work orders - switching orders - street light service requests		
5.6	The system shall generate a resource-loaded schedule of distinct work order tasks assigned to distinct crews for the next 6 calendar weeks.		
5.7	The system shall treat emergency and outage types of tasks with higher priority and schedule the closest qualified crew to be dispatched.		
5.8	The field crew will be given the option to keep their previously assigned work orders for the day when they receive a trouble event.		
5.9	The system will automatically reschedule all work order tasks sent back to it by field crews when they accept new trouble work order tasks.		
5.10	The system will generate the forecasted resource skill requirements for all work orders with need dates within the next 6 months.		
5.11	The system will accept maintenance and inspection work orders and use them to fill out the day for all qualified crews.		
5.12	The system shall accept as input the personal calendar for each Crew member.		
5.13	The user shall be able to enter the company's workday calendar and shift definitions.		
5.14	The system shall accept appointment requests.		
5.15	The system shall generate a list of 10 alternative time slots if the requested appointment time slot is not available.		
5.16	Describe the type of location details required to be included as part of a work order to be auto scheduled and dispatched.		
5.17	Describe the skill type details required to be included as part of a work order to be auto scheduled and dispatched.		
5.18	Describe the inter work order dependencies details required to be included as part of a work order to be		

Req. ID	Field Management	Capability Supported?	Bidder Response
	auto scheduled and dispatched with its related work orders.		
5.19	Describe the system's scheduling algorithm in enough detail to address how the system ensures two different crews with similar skill sets won't be assigned work orders on the same street and area in the service territory.		
5.20	During major storm events, the system will take back all work orders from their scheduled crews, generate a new schedule based on the estimated restoration times for all of the known outages and generate a list of customer executives to be paged and/or a list of customers to be called or to receive a mailer to notify them that their work order has been rescheduled past its need date.		
5.21	The user shall be able to generate a schedule for this week, this month, or the next two months and either: print a hard copy post it to all crews personal calendars		
5.22	Please provide the hardware Requirements required executing the scheduling module.		
5.23	The system shall auto dispatch to the field a complete days' worth of work before the crews sign on for their shift.		
5.24	The system shall dispatch all work orders previously dispatched to a crew who doesn't sign on within 10 minutes of his shift's scheduled start time.		
5.25	The user shall be able to manually dispatch a crew to a work order by dragging the crew to the work order or the work order to the crew.		
5.26	The user shall be alarmed when a crew is in jeopardy of missing his current work order's estimated end time, so the dispatcher can proactively take over the rest of the crew's work orders and reassign them.		
5.27	The user shall be presented all crews in a scrollable tabular list.		
5.28	The user shall be presented all work orders in a scrollable tabular list.		
5.29	The user shall be able to sort all tabular lists by any combination of fields that are displayed.		
5.30	The user shall be alarmed when the system attempted to auto dispatch a trouble or emergency work order and the crew hasn't acknowledged it within a user defined period of time.		
5.31	For each type of work order, Describe the life-cycle model supported by the dispatching module.		
	The user shall be able to print a copy of the day's schedule by crew.		

Req. ID	Field Management	Capability Supported?	Bidder Response
5.32	The user shall be able to replay the history of a crew's location for the past 6 months.		
5.33	The system shall automatically re-dispatch all work orders not marked to stay with the crew at the end of the shift.		
5.34	The system shall be able to send to the field either with the original trouble work order header information or as requested by the field, a map of the probable outage device, a list of critical customers affected, a list of customers who have called in, a list of all customers affected and the alternative views that contain the various customer lists plotted on the outage map as well.		
5.35	The system shall be able to send to the field either with the original trouble work order header information or as requested by the field, details associated with each of the customers affected, including the actual text message collected by the customer service representative.		
5.36	The system shall be able to track when a work order has been dispatched, acknowledged by a crew, crew is in route, crew has arrived at the location, crew has restored service and crew has completed work order.		
5.37	Please provide bandwidth and throughput metrics and bandwidth recommendations for the following type of connections: LAN, WAN, modem and wireless; for these types of work load scenarios: • The down load of a day's set of work orders • Trouble work order set of maps and related details • Interactive timing metrics of field entered estimated restoration times and device state changes • Upload of a day's worth of orders to be re-dispatched for crews who are getting trouble work orders • Upload of a day's worth of work order completion details • Upload message traffic of your AVL component • Traffic required to support field user on demand queries for detailed customer information, work order information, outage summary information		
5.38	Please provide the set of wireless mediums and protocol supported by the dispatching and field components		
5.39	Please provide the hardware requirements of the dispatching module to handle 200 crews being managed by 4 dispatchers and 48 Zone offices		
5.40	The system shall allow centralized and de-centralized business models. Normal dispatching is typically done centrally. Certain severe storm situations may require		

Req. ID	Field Management	Capability Supported?	Bidder Response
	de-centralized dispatching. Describe the scalability of the system to support both business models.		

F.10.7. Outage Web Portal

The OMS provides a customer facing outage mapping portal (i.e, on corporate website) that geographically displays known outages and provides basic outage status information including the number of current outages, number of affected customers, and expected restoration times per outage. Ensure outage mapping portal dynamically updates based on new, dispatched or restored outages.

The OMS shall have an optional customer facing Outage Web Portal.

Verified outages shall be automatically pushed from the OMS to the Outage Web Portal without the need for operator intervention. Outage Web Portal application should have the ability to:

a. View locations and the extent of existing outage cases
b. View outage ticket information such as cause, estimated time of restoration and information messages from the system operators
c. Allow customers to submit outage reports
d. Allow customers to view a list of all planned outages

The Outage Portal shall use mapping technology such as Microsoft Bing Map, Google Map or Open street Map as the underlying background mapping technology.

The outage pushpins on the map point to where the outage is located. Clicking on one navigates to and highlights the area associated with that outage, and displays an outage ticket containing the outage details.

The Outage Web Portal application can be used from a desktop, a laptop or a tablet, however, the application is optimized for handheld mobile devices such as smartphones.

Operators shall have the ability to update the following information on the Outage Web Portal including:

a. Estimated time of restoration
b. Outage Cause
c. Pre-defined message from a dropped down list of pre-defined messages
d. Free form message

The outage portal shall be connected in real-time to the OMS system, however it should be isolated on its on DMZ and can only access the OMS via middleware server to ensure the security of the system.

F.10.8. Notifications

The OMS shall be able to integrate with IVR and corporate website to provide notification of planned and unplanned outages status via customer phone lines (work phone, cell phone and home phone, etc.), emails, or text messages to customers.

The OMS shall provide method(s) to contact a customer electronically with outage status updates using IVR, Email, and SMS text messaging.

F.10.9. Tabular List

a. All dynamic lists have sorting capability on any column, including the capability to have multiple nested sorts, in order to rank and sort outages in an order that is quick to locate information (i.e., medical alert customers).
b. All dynamic lists have filtering capability, with the ability to filter on multiple fields.
c. The sorts in the outage list can be sorted at a minimum with the following column information: customer hours and minutes interrupted priority customers, customer type, outage types and number of customers out.
d. The OMS dynamic list of grouped calls supports a dynamic status indicating current status of event (acknowledge, crew on site, ETA, restored).
e. OMS has the functionality to generate estimated restoration times for each outage with the ability for manual override of the calculation.
f. The OMS solution has the ability to provide an estimated number of customers out of power (versus actual), per outage prediction.
g. The OMS dynamic list have the ability to filter on multiple fields and the ability to export in xml format or other reporting generators.

F.10.10. Non-Outage Call/Events Handling Application

a. The ADMS shall have the ability to handle tickets which may or may not be related to outages
b. The ADMS shall have the ability to distinguish between Emergency Tickets and Service Tickets
c. Emergency Tickets are related to critical items from a network and public safety point of view. These must be addressed before an outage can be closed
d. Visual indicators must be available to flash in order highlight and bring operator attention to any outstanding emergency items.
e. Service Tickets are related to non-outage related items such as tree branch trimming, maintenance work, etc. These should be maintained on a separate list which is easily accessible to the operator.

F.10.11. Storm Management

a. An optional Storm Management Module (SMM) shall be available to be added on to the ADMS
b. The SMM should have the ability to group outages together under a Storm, e.g. Irene, Sandy
c. Grouping outages under a Storm shall provide the following abilities
    i. Generate reliability and outage statistics for the storm – such as the number of customers effected by the storm, total customer interruption minutes, number of switch operations, etc.
    ii. The SMM shall have a complimentary tablet based feature which can be used for damage assessment. Damage Assessment personnel can use these tablets to gather data related to damage.
d. The tablets can be connected in real-time with the ADMS to upload the damage reports and allow dispatchers to dispatch crews to rectify the damage.
e. Tablets may optionally also be offline without any internet connectivity. Once the damage assessor is back in the office the damage assessment reports can be uploaded to the ADMS.
f. Damage reports shall be easily accessible by dispatchers via the ADMS GUI.

F.10.12. Reliability Indices

The system shall provide the ability to calculate quality of service indices that can be used to track and report on the performance characteristics of OPTCL Distribution Network over various time periods specified by the user. This shall include quality of service indices pre-defined in the database or created by the user on-line

At least, the following quality of service indices shall be implemented: SAIDI, MAIFI, SAIFI, and CAIDI.

The standard ADMS reporting package should generate standard Reliability index reports for user supplied time frames; and in real time. These reports should be able to run by equipment, customer, or system wide for the previous year, year to date, rolling twelve-month period, previous month(s), current month to date, previous week or day. Reports to include: SAIFI, SAIDI, CAIFI, CAIDI, and MAIFI. The OMS standard reports calculate the reliability indices; with and without the inclusion of outages for major event days and/or loss of supply.

The user shall be able to calculate the quality indices at any voltage level & area specific i.e. district wise. The user shall be able to view the quality of service indices and the variables used to calculate them via interactive displays that allow the user to:

a. Create, verify, and edit quality-of-service formulas
b. Verify and edit individual values of the calculation variables
c. Enable and disable one or more index calculations
d. Enter schedules for index calculations.

The calculation variables shall include any values available, including real-time and historical data. Tools shall be provided to compare sets of indices created at different times and over different time periods. These tools shall allow statistical information to be generated for user-selected indices. In addition, the user shall be able to generate, review, and schedule reports based on the quality of service indices.

Example for calculation of different indices is shown below. The actual calculation formula will be decided by TP-DDL during project implementation.
Given the following symbols definitions:
Ni = number of interrupted customers per interruption event i
NT = total number of customers served
ri = restoration time per interruption event i,
the Contractor shall implement the quality of service indices defined as follows:

SAIFI = Ni / NT
MAIFI = Ni / NT, where only events of duration less than 5 minutes are counted
SAIDI = ri Ni / NT
CAIDI =ri Ni / Ni
Where:
SAIFI = System Average Interruption Frequency Index
MAIFI = Momentary Average Interruption Frequency Index
SAIDI = System Average Interruption Duration Index
CAIDI = Customer Average Interruption Duration Index
The above indices shall be calculated for up to different customer categories as defined by OPTCL

F.11 USER INTERFACE REQUIREMENTS

F.11.1. General Requirements

This chapter describes the User Interface requirements for the SCADA/DMS-OMS system. All SCADA/DMS-OMS functions shall have common user interface as user interaction shall be performed from Operator Consoles envisaged in this specification. All user interactions shall be from full graphics display.

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

F.11.2. System Users

The term "user" is applied to the personnel interacting with the SCADA/DMS system. These users shall be required to login in one or more of following user modes, which include:

a. Supervisor Personnel responsible for SCADA/DMS system administration and management such as assigning the access area to users, creating users etc.
b. Dispatcher Personnel responsible for real-time Power system operations including real-time study.
c. Engineer Personnel having access to certain SCADA/DMS system functions and maintenance of database/ displays and responsible for support activities such as post fault analysis , report generation, regular backup of database
d. Programmer Personnel responsible for continuing development and maintenance of the SCADA/DMS system functions, databases, displays and report formats. Security system
e. Remote VDU user : Personnel having only monitoring access of real-time power system from SCADA/DMS system , reports..
f. DTS (Instructor & Trainee modes): The Consoles dedicated for DTS shall have instructor & trainee modes . The requirements are defined in section F.9.

The role, accessibility for each mode is defined as above, However, the OPTCL with login as supervisor shall be able to assign the operation of certain functions, or features of functions, to specific user modes. OPTCL, shall maintain the privileges as specified to each user mode .Each individual user shall be assignable to anyone or more user modes. User access to all SCADA/DMS functions shall follow a consistent set of common user access guidelines. A mechanism for defining and controlling user access to the SCADA/DMS system shall be provided. Password security shall be provided for access to the SCADA/DMS system, its operating system, layered products, and other applications. Each password shall be validated against the corresponding user information in the database. Users shall have the ability to change their own passwords.

Number of logins to be provided to the Purchaser – To be informed by the Purchaser during the designing and commissioning phase.

F.11.3. Function and Data Access Security

After a user has successfully logged on, access to the SCADA/DMS functions, displays, reports, and databases shall be restricted by pre-assigned operating jurisdictions. These operating area assignments shall be made when the function, display, report, or database element is defined.

The access security function shall compare the user's assigned operating jurisdiction against the operating jurisdictions assigned to the function, display, report, or database element each time a user attempts a console action, such as:

a. Calling a display
b. Entering or changing display data
c. Viewing, editing, or printing a report
d. Executing a supervisory control action

There shall be no restrictions on the assignment of multiple jurisdictions to a console & user or the assignment of a jurisdiction to multiple consoles & users. The access security function shall ensure that each jurisdiction is at all times assigned to a least one console. If a console failure or manual reassignment of jurisdiction results in one or more jurisdictions not being assigned to at least one console, the unassigned jurisdictions shall be automatically assigned to a pre-assigned default console and suitable alarms shall be generated.

SCADA/DMS users shall not required additional login (user name and password) to the other facility allowed as per operating jurisdictions such as ISR. “Single Sign-On” (SSO) technology be employed (i.e., a user logs on once to the SCADA/DMS using individually defined user name and password which permits appropriate level of access to all SCADA/DMS facilities, including IS&R. Further, the facility should be compatible with enterprise-wide SSO capabilities.

Each log-on and log-off shall be reported as an event. Unsuccessful attempts to log-on shall also be reported as events.

F.11.4. Windows Environment

The user interface software shall be based on state-of-the-art web-based technology to present interactive, full-graphics views of system data via LAN, corporate intranet or the internet. The same displays shall be used.

It is essential that the same web-based user interface (same navigator, same tools) be available to the operator either for local use in the dispatching center or remotely.
Cutting-edge UI technologies:

a. Worldmap Viewer based on Qt and Open GL (or comparable) for displaying graphic information (schematic diagrams, geo-spatial diagrams, and real-time trends). Key features
    i. Support for large schematic and geospatial diagrams.
    ii. Cross platform support (can be used on Linux, Microsoft Windows, and Mac OS X).
    iii. Modern real-time 3D rendering.
    iv. Native implementation with high speed rendering.

b. WebSDK toolkit (HTML 5) and JBoss Enterprise Application Server for applications like Alarm Summary and Application displays (tabular and chart representation). Key features
    i. Easy creation and modification of application displays (simple XML change)
    ii. Common look and feel across all applications
    iii. Rich client user interface
    iv. Manual software updates shall not be required

The Web-based user interface shall provide SGCC access from Windows PCs as well as Linux work-stations. It shall offer a single user interface for control center, back office, and remote access, using compressed and encrypted data transport.

The web technology shall be natively supported by the DMS product, which means that having the displays shown in the web browser shall not bring additional work to the maintenance engineer at display building time. Nor shall it require additional third-party software products like specific plug-ins. The web user interface shall support and enforce all security features described in the following sections.

F.11.5. Display interactions

Rapid, convenient, and reliable display requests shall be provided using the following methods:

a. Display Requests
   i. Selection of a display from a menu display
   ii. Cursor target selection on any menu, graphic, or tabular display
   iii. Selection of an alarm : in this case, it shall call up the one-line display containing the alarm's location,
   iv. Selection of an alarm or event message on a summary display followed by a display request command
   v. Selection of display by Entering a display name or number
   vi. Forward and reverse paging in a page-based display.
   vii. Selecting a previous display by re-call command.
   viii. Selecting a point of interest from an Overview display for viewing on full screen (such as viewing a SLD of a substation by selecting the Substation node from a Network diagram).
   ix. Selecting function keys or cursor targets dedicated to displays.

F.11.6. Display navigation

Display navigation methods shall provide a consistent approach for moving within a display. The following methods shall be provided:

a. Panning with cursor positioning device or scroll bars
b. Zooming with cursor positioning device
c. Navigation window for rapid movement between portions of a world display
   i. Rubber-band zooming.
   ii. Tool tip
   iii. Find & locate
   iv. Drag & drop

Zooming shall affect the magnification level of the data displayed. Panning shall move the viewed portion of a world map space. The size of the viewed portion of the map relative to the whole display shall be indicated by the width of the sliders in the scroll bars of the window displaying the sector. When a display is first called up in a window, it shall be automatically scaled as per default zoom level.

Both continuous and discrete panning and zooming control shall be provided. Continuous panning and zooming shall be done in a convenient and intuitive way using the mouse; and the resulting changes in the screen contents shall be "smooth" and instantaneous without any noticeable delay. Discrete panning and zooming in larger steps shall be possible by dragging the mouse, using the keyboard, and clicking on pushbuttons on toolbars.

When only a part of the display is shown in the active window, the user shall be able to request a "navigation" window for orientation. This window shall show a small replica of the complete display,

with the displayed sector of the display highlighted. The user shall be able to move the navigation window anywhere on the screen, and shall be able to close it.

A decluttering mechanism that defines the visibility of a graphic construct as a function of its magnification shall be provided. As zooming changes the magnification of data displayed, the declutter mechanism shall cause levels of detail to be shown or suppressed.

The magnification range corresponding to each declutter level shall be defined as system configuration parameter. Static and dynamic element within a display shall have associated with it a visibility designation as yes or no for each
In addition to reaching the various decluttering levels through zooming, users shall also be allowed to request a specific level from a dialog menu.

The user shall be able to scale (zoom) the image of a world co-ordinate space or display in a smooth fashion to any convenient scale factor. The scale factors shall allow the presentation of an entire world co-ordinate space or display on the full screen or a window.

Static and dynamic data shall be displayed and updated during a scaling operation, and display text shall be scalable to be consistent with the scaled image. At defined scale factors, levels of de-clutter shall be invoked.

The user shall be able to select an area of a world co-ordinate display by cursor manipulation ("rubber-banding") and cause the display to be redrawn with the selected area centered in the display and with the selected area magnified to best fit the full window. The window dimensions shall not be changed by such an action.

A tool tip or equivalent method shall be provided for displaying information in English text & numeral upon moving cursor on the device etc.

Find & locate feature to take the user to the on-line/ network display where the particular component exists.

Permanent Indicators

i. Several indicators, including those listed below, shall be permanently shown on each SCADA/DMS-OMS Display screen as minimum:
ii. Date and Time: Date shall be presented in the format DD/MM/YY. Time shall be presented in the format HH:MM:SS with a resolution of one second, and shall be updated once per second.
iii. Username: Name of the user logged in the SCADA/DMS
iv. Name of the active server
v. Name of the SCADA/DMS display accessed
vi. Name of the display window
vii. Default Screen Layout

It shall be possible for each user to define a personal layout (Rooms) for the screens displayed on the screen(s) of the workstation, i.e. to define a personal default setup of the position, size, and contents of the screens.

The user's default layout shall appear when the user logs on to a workstation. When a dispatcher takes over a new shift by logging on without the previous dispatcher logging off first, the current screen layout shall be preserved. It shall be possible to go to another room layout of the logged on user at any time.

F.11.7. Display Note pad

An user shall be able to place and edit a note on bays , devices etc on any display. A symbol shall appear on the display indicating the presence of Note on that display. The content of the note shall be callable using a cursor target.

F.11.8. Quality Code and Tag Indication

All displays and reports containing telemetered analog values, device status and calculated values shall have a data quality code associated with each data field. The quality code shall reflect the condition of the data on the display or report. When more than one condition applies to the data, the symbol for the highest priority condition shall be displayed.

A separate indicator shall identify the devices that have supervisory control inhibit tags. When more than one tags are present on a device, the highest priority tag shall be displayed.

F.11.9. User Interaction Techniques

The user's interaction with the SCADA/DMS system for power system operations shall primarily be accomplished using a menu item selection technique. The first step in the interaction will be selection of the item to be operated upon. The user shall then be provided a menu of operations applicable to the selected item. The required operation alternatives include:

a. Supervisory control
b. Data entry
c. Device status entry
d. Scan inhibit/enable
e. Tag placement/removal
f. Trend.

A set of parameters shall be presented appropriate to the item type and operation to be performed. For example, selecting a device for control shall cause a menu of control actions to be presented. Selecting an analog value for trending shall cause a menu of parameters, such as range and trend rate etc., to be presented.

As appropriate for the data and function requested, a menu containing output destinations such as screen, printer, or file shall be presented. When the destination is selected by the user, the requested action shall begin. It shall not be necessary to select an execute command to complete the interaction except for supervisory control actions.

The user shall be able to end the interaction sequence at any time by selecting a cancel command. The progress of all user operations shall be monitored. If the user does not complete to a step within a multi-step operation within a pre-defined time, the process shall reset, and the user shall be informed of the reset. A partially completed action shall be reset if the user begins another non-related sequence.
A programmer-adjustable time-out cancel shall also be provided.

F.11.10. User Guidance

The SCADA/DMS-OMS system shall respond to all user input actions indicating whether the action was accepted, was not accepted, or is pending. For multi-step procedures, the systems shall provide feedback at each step. User guidance messages shall be English text and shall not require the use of a reference document for interpretation. User shall be guided for multiple options. The use of mnemonics is prohibited, unless the mnemonics are industry-accepted or approved by employer. Provisions are required for administrators to edit the toolbars and menus, user guidance messages and to construct new ones through an interactive procedure and without programming.

F.11.11. User Help

In addition to the user guidance, general and specific context-sensitive on-line help shall be available to the SCADA/DMS-OMS user. Context sensitive means that the help information provided shall be applicable to the next step or steps in the sequence being performed. The Help menu shall present a list of topics available for reference. The topics shall refer to the SCADA/DMS-OMS user documents. The ability to scroll through the topic's explanatory text shall be supported.

The Help button in a dialog box and help key shall present the text of the user documents where use of the dialog box is explained. The user shall be able to scroll through this text. Exit from the help facility shall return the user to the same point in the sequence for which help was requested.

Context sensitive help facilities shall be provided for each application software package and operator display. The capability to easily edit or add additional help facilities in the future shall be provided.

The provided help facility shall also support:

a. search mechanism
b. navigation links between related topics within the help documents
c. select/copy mechanism
d. print facilities

F.11.12. Overlapping user access

The ability to queue multiple commands from different consoles shall be provided. In this regard, however, interlocks shall be provided to avoid overlapping user access to certain functions such as data entry and supervisory control as follows:

a. Data Entry: Although the same data entry field , device status entry or fields (in the case of full-page data entry) may appear concurrently in multiple windows at multiple consoles, data entry for the field or fields shall be restricted to one window at one console at a time. An attempt to initiate data entry for the field or fields from another window shall result in a user guidance message. Concurrent data entry on different areas of a world display, however, shall be allowed.

b. Supervisory Control: Although the same power system device, such as a circuit breaker, may appear concurrently in multiple windows at multiple consoles, control of the power system device shall be restricted to one window at a console at a time. An attempt to initiate control of the power system device from another window shall result in a user guidance message.

F.11.13. Function Key Usage

Special functions shall be assigned to the 12 function keys on a standard keyboard. With extensions (e.g., Shift, Alt, Esc) this shall result in a minimum of 48 function key actions.

F.11.14. Trend

Trend shall be a display of series of values of parameters on a time axis. Both graphical trend and tabular trends shall be supported. The attributes of the trend display shall be user configurable. The trend application shall be able to show trends for any measurement type from more than one source, at least from real-time, historical and forecast sources. It shall be possible to combine this data showing data for comparison using a shared timeline simultaneously comparing for example yesterday (historic) and today (historic, actual and forecast) as two curves on the same time axis.

It should be possible to trend different types of parameters (P, Q, V, I, F etc.) with associated Scales on the same display. The user shall be able to select a trend rate different than the sampling rate.

It shall be possible to illustrate all types of process data (historical and real time) as trends – input and output data, binary and analogue data. The trends shall be displayed in graphical form as column or curve diagrams with a maximum of 128 trends per screen. Adjustable time span and scaling ranges must be provided. The system shall have the ability to have an unlimited number of windows on a monitor. Trend shall have the ability to superimpose two different time frames in a single window for comparison.

F.11.15. Graphical Trend

The user shall be able to select and configure trending on Graphical displays enabling user for entry of the following parameters:

a. Data value name
b. Trend header
c. Trend direction (horizontal or vertical)
d. Scale (unidirectional and bi-directional)
e. Zero offset
f. Trace number, colour & texture
g. Trend data rate
h. Trend start time and date (historical data only)
i. Total trend duration (historical data only)
j. Reference lines or shading axes (With default to restrictive alarm limits)
k. Windows/chart to be used
l. Simultaneous trending of different parameters with associated scales.

Trending of at least four values simultaneously, on a common axis or separate axes shall be supported. All scales corresponding to the values selected shall be visible on the Trend Display simultaneously. There shall be automatic movement of data down or across the screen as new values are generated. When the number of real-time trend samples reaches the limit that can be displayed, the oldest value shall automatically be removed as the display is updated.

The magnitude & time of all the trended quantities at a particular time instant shall be displayed when the cursor is placed on the timescale on the trend display.

When historical data is selected for trending, the user shall be able to page forward and backward, or scroll by the use of a scroll bar, through a non-updating snapshot of the data within the constraints of the data stored in the historical files.

Shading between each trend value and user-definable axes shall be provided. Trend colour shall be changeable based on a comparison of the trend value against associated alarm limits.

It shall be possible to have at least data samples corresponding to 2 months on line storage for each of the trended variable. The user shall be able to print the trend without interfering with the continuing trending process.
Tabular Trending

Tabular trending shall be a listing of the time-sequential values of a variable/ variables. The tabular trend shall present the data in a tabular form with one column for Date/time and additional columns for each of the trended variable. The tabular trend shall contain at least rows for samples corresponding to 2 months on line storage. Each row shall contain the values of the trended variables. It shall be possible to scroll up and down to see the rows. The sampling rate shall be individually definable for each tabular trend. The historical tabular trends, which shall be produced from the

previously stored values in trend files, it shall be possible to choose the start time, the end time, and the sampling rate independently of the sampled rate of historical data.

It shall also be possible to save trend output to an ASCII file. The file output shall be in ASCII format, with date and time information and the engineering unit value of the trended variables for each collection interval. The user shall be able to print the trend on a user-selected printer without interfering with the continuing trending process.

F.11.16. Alarms

Alarms are conditions that require user attention. All alarms shall be presented to the user in a consistent manner. Alarm conditions shall include, but not be limited to, the following:

a. Telemetered or calculated value limit violations
b. Values returning to normal from a limit violation state
c. Uncommanded changes of a power system device state
d. SCADA/DMS-OMS application program results
e. Data source communication errors resulting in loss of data
f. SCADA/DMS-OMS system hardware or software failures.

Each alarm shall be subjected to a series of alarm processing functions. A device or value's alarmable conditions shall be assigned to an alarm category and alarm priority levels. Alarms shall also be subjected to advanced alarm processing. The results of the alarm processing shall determine the console(s) that will receive and be authorized to respond to the alarm and the associated actions with the alarm. All alarm messages shall be recorded on auxiliary memory of SCADA/DMS-OMS system and archived in chronological order & reverse chronological order. It shall be possible to sort, display and print user selected alarm messages from any console by the user.

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

F.11.17. Alarm Categories

An alarm category provides the logical interface that connects an alarm condition to a specific Area of Responsibility (AOR) or operational jurisdiction as defined and accordingly alarm shall be reported to user. Every alarm shall be assignable to a category. Each category shall, in turn, be assignable to one or more users. A means shall be provided for changing operating shifts without reassignment of alarm categories at a console. Each log-on and log-off shall be reported as an event.

F.11.18. Alarm Priority levels

Each alarm shall be assigned to an alarm priority level. Up to 8 alarm priority levels shall be supported. Each alarm priority level shall be presented in separate display. For each alarm, it shall be possible for the programmer to independently configure the following actions:

a. Audible alarm tone type selection and its enabling/disabling
b. Alarm messages to be displayed on an alarm summary
c. Alarm message deleted from alarm summary when acknowledged
d. Alarm message deleted from alarm summary when return-to-normal alarm occurs
e. Alarm message deleted from alarm summary when return-to-normal alarm is acknowledged
f. Alarm message deleted by user action.

This assignment shall determine how the alarm will be presented, acknowledged, deleted, and recorded.

F.11.19. User Interaction for Alarms

The User shall be able to perform the alarm interactions described below.

a. Alarm Inhibit/Enable : Inhibiting alarms for a value or device, including a complete RTU /FRTU/FPI or other data source, shall cause all alarm processing of that value or device to be suspended. The action shall be recorded in the event log. However, Scanning of the value or device shall continue and the database shall be updated.

b. Alarm Acknowledgment : An alarm shall be acknowledged by selecting an alarm acknowledge command when the item in alarm is selected on:
    i. Any display showing the item in alarm
    ii. Any display showing the alarm message.

    User shall be able to acknowledge alarm individually, by page, user selected manner. It shall be possible for the user to distinguish persistent & reset alarms under acknowledged & unacknowledged conditions. All alarms shall be stored by the system
    Audible alarm silencing

    User shall be able to silence alarm without acknowledgement and shall remain until the user enable the audible alarm. The silencing & enabling shall be recorded as event. The tones shall be definable on the console basis. For each console, multiple tones shall be available. Tones shall be of continuous & short duration type both. The former shall be of high priority condition & require operator intervention to stop. In case of short duration tone, it shall go off at it's own.
    Change Alarm Limits

    The user shall be able to change the alarm limits.. When the user selects an item to change its alarm limits, a menu showing the alarm limits currently in use and a data entry field for the revised limits shall appear. All changes to alarm limits shall be subjected to data entry error checking and recorded as events. The alarms shall be annunciated according to the changed alarm limits. The user shall be able to reset alarm limits to the limits set in the SCADA database. However, these shall be treated as temporary changes & if the system is re-initialised, the original limits defined in the SCADA database shall be operationalised.

c. Alarm Presentation :Alarm presentation shall be determined by the alarm's category and priority. Displays shall highlight every alarm condition using a combination of colour, intensity, inverse video, blinking and audible sound. The alarm condition highlighting shall show whether the alarm has been acknowledged. The highlighted alarm condition shall appear on all displays containing that device or value at all consoles regardless of the alarm's category. Alarm messages shall be a single line of text describing the alarm that has occurred and the time of occurrence. The alarm message shall be English text and shall not require the use of a reference document for interpretation.

F.11.20. Events

Events are conditions or actions that shall be recorded by the SCADA/DMS system but do not require user action. Events shall be generated under the following conditions

a. User initiated actions
b. Conditions detected by application functions that do not require immediate user notification but should be recorded.

Events shall be recorded in the form of an event message. The event message format shall be similar to the alarm message format. The same message format shall be used for displaying and printing events. Event messages shall be displayed on an events summary.

Event messages shall be stored on auxiliary memory of SCADA/DMS system and archived in chronological order and reverse chronological order. It shall be possible to sort, display, and print event messages from any console.

F.11.21. Hardcopy Printout

The SCADA/DMS-OMS system shall have features to produce a print out of a display, reports, Alarms, Events etc. from a menu. Any of the available printers shall be selectable by the SCADA/DMS-OMS users from menus for taking printout.

It shall be possible to print a complete display or a selected portion of a display. The options for printing shall include at least choice for orientation, background colour, page size, colour/ black & white and print preview. Also any of the available printers shall be selectable from the print Menu.

F.11.22. Report Generation

The contractor shall be required to generate the Daily, Weekly, Monthly reports formats for SCADA/DMS-OMS system. The report formats shall be finalised during detailed engineering stage. The user shall be able to schedule periodic generation of reports, direct report to display, print report, and archive report using report-scheduling display. The report scheduling display shall enable entry of the following parameters, with default values provided where appropriate:

a. Report name
b. Report destination (printer or archiving device)
c. Time of the system should produce the report.

The user shall be able to examine and modify the contents of reports for the current period and for previous report periods using displays. Any calculation associated with the revision of data in a report shall be performed automatically after data entry has been completed.

The report review displays shall accommodate formatted report pages up to132 characters in width and 66 lines in length (or better) and shall contain headings that correspond to the printed report headings. For reports containing more columns or rows than the display, the system shall include a means to view the entire report in a graphic format. The report view and editing displays shall function with the initially supplied reports and all future reports added by employer.

F.11.23. System Configuration Monitoring and Control

The user shall be provided with the capability to review SCADA/DMS-OMS computer system configuration and to control the state of the configuration equipment using displays. The following operations shall be possible:

a. Failover of each server
b. Monitoring of servers, device, including workstations, RTUs, FRTUs,FPIs, status & loading of WAN LANs etc.
c. Monitoring of the processor resource, hard disk & LAN/WAN utilization
d. Control & monitor of SCADA/DMS-OMS functions

F.11.24. Dynamic Data Presentation

It shall be possible to present any item in the database on any display. All supervisory control and data control capabilities shall be supported from any window of a world display. Device status or data

values shall be displayable anywhere on the screen, excluding dedicated screen areas such as the display heading.

Only standard X Window system or Microsoft windows standard fonts shall be provided with the SCADA/DMS-OMS. All fonts supplied shall be supported on the user interface devices and all printers supplied with the system. The types of fonts to be used in a particular display shall be selected at display definition time. Status and data values shall be presented in the following formats as appropriate:

a. Numerical text that presents analogue values shall have the provision for the format definition of the text shall include the number of characters, number of decimal places, and the use of positive /negative sign or flow direction arrows, etc.
b. Normally the telemetered MW/Mvar values along with the sign/direction shall be displayed on the Single line diagram and Network diagram. However the user shall also be able to display all other telemetered and calculated/ estimated analog values (I, V, pf etc. for each phase) on the Single line diagram (SLD) and Network diagram. All the displays shall be suitably designed to view 12 telemetered and 12 estimated/calculated values simultaneously for each feeder.
c. Symbols, including alphanumeric text strings for an item, based upon state changes e.g., circuit breaker (OPEN/CLOSE/ INVALID).
d. Symbols, including alphanumeric text strings for indicating the data quality flags.
e. Colours, textures, and blink conditions based upon state or value changes or a change of data quality, e.g., alarm limits.

F.11.25. Element Highlighting

Element highlighting techniques shall be provided to draw the attention of Dispatcher to critical state of the system. The highlighting technique shall include change of colour, colour intensity, blinking, Character inversion, Line texture, appended symbols etc. This feature shall be used to highlight alarms, power system device and measurement status, data quality, data entry locations on a display and error conditions.

F.11.26. Display Types

The following list describes the types of displays that are to be included in the SCADA/DMS system. The user interface shall support the capabilities of all displays as specified. The User mode, Current Time and date shall be displayed on a screen-basis, not on a display basis, and shall be always visible.

F.11.27. SCADA/DMS System Display

A display shall be provided that lists all SCADA/DMS system directory displays. The displays shall be listed in alphabetical order with suitable separation in the list to enhance readability. Each entry in the list shall have a cursor target for display selection.

F.11.28. Distribution System Network Display

A graphic overview network display of the distribution system with substations, feeders. Distribution network colour coded by voltage shall be provided. This display shall present the distribution system in a graphic format provided by employer. Telemetered and calculated data like Real and reactive power flows shall be displayed as a value with a direction arrow/positive- negative signs. Lines that have exceeded their loading limits shall be highlighted. Substations and power stations shall be depicted by symbols that reflect the presence of alarms at that substation or power station. Cursor selection of a substation/ power station symbol shall result in the associated Single line diagram display for that substation/ power station.

F.11.29. Interchange Display

The interchange display shall be provided as a schematic diagram showing power transfers among various utilities. This diagram shall show each power system as a block with actual and scheduled net interchange values outside the block. Symbolic arrows shall indicate power flow directions. The diagram shall also show schedule deviations. This display shall show the frequency values collected from all substations having tie-lines.

F.11.30. Substation SLD displays Menu

A display shall be provided that lists all substations that can be viewed via a SLD display. The name of the SLD displays shall be listed in alphabetical order, according to substation name, with suitable separation in the list to enhance readability. Each entry in the list shall have a cursor target for graphic display selection.

F.11.31. Substation SLD Displays

SLD displays shall be provided for each substation, including those for which telemetry may not be available but are required for running the DMS applications. Each display shall present telemetered, manually entered, and calculated power system data on a Single line diagram that shows substation layout in terms of its buses, switches, lines, and transformers. The feeder names in the SLD shall have linkage with remote substation end SLD, distribution network associated with that feeder. It shall be possible to move to remote-end substations SLD by selecting this feeder. The user shall be able to perform any user interaction defined by the Specification on these displays.

F.11.32. Control panel displays

As utilities are presently using conventional panels at S/S for supervision & monitoring, The control panel displays giving look -alike feeling shall be provided for operator supervise & operate.

F.11.33. Substation Tabular Displays

Tabular displays shall be provided for each substation. These displays shall list the real-time values of telemetered, manually entered, and calculated data associated with the substation as well as related information such as alarm limits. The user shall be able to perform any user interaction defined by the Specification on these displays.

F.11.34. Alarm Summary Displays

Displays that list or summarize all unacknowledged and acknowledged alarms shall be provided. The summary shall separate acknowledged and unacknowledged alarms. Capacity shall be provided for at least 200 alarm messages for each alarm summary type. If an alarm summary display becomes full, the oldest messages shall be automatically deleted and the newest messages shall be added. It shall be possible to perform any alarm interaction from this display. The user shall be able to select between viewing events in chronological or reverse chronological order.

F.11.35. Event Summary Displays

Event summary displays shall list the most recent events and shall be organized by category for those categories assigned to a given console, as one summary display for all categories assigned to a console, or by all conditions system-wide without reference to the categories assigned to a console, as selected by the user. The user shall be able to select between viewing events in chronological or reverse chronological order.

F.11.36. Operating Information Summaries

The operating information summaries defined below shall be provided. Summary items shall be listed in reverse chronological order with the most recent item shown on the first page. All summary displays, except for Tag Summary shall be information-only displays; no user interaction, other than

display call up, shall be associated with them. The Tag Summary shall be interactive, i.e., the user shall be able to place or remove tags on this summary.

F.11.37. Manual Override Summary

The manual override summary shall list all telemetered and calculated device status and data values for which a user has substituted a value

F.11.38. Off-Normal Summary

The off normal summary display shall list devices and values that are found to be abnormal, i.e., are not in their normal state. Telemetered, calculated, and manually entered status and data values shall be included.

F.11.39. Out-of-Scan Summary

The out-of-scan summary display shall list device status and data values that are not currently being processed by the system. If an entire telemetry source such as an RTU /FRTU /FPI is out-of-scan, the out-of-scan summary shall display the source without any of the individual device status or data values associated with the source

F.11.40. Alarm Inhibit Summary

This display shall list devices and data values for which the user has suspended alarm processing.

F.11.41. Tag Summary

This display shall list and describe all active device tags.

F.11.42. Graphical Trending Summary Displays

The summary display shall list all items being trended. The list shall include the item name, trace number or colour, trend orientation, and trend range. The summary display shall list all items being recorded for tabular trends. The list shall include the item name and the file name.

F.11.43. Notes Display

This display shall include a minimum of 5 pages on which a user at any console may enter and edit messages. The contents of these pages shall be accessible by any console. The user shall have the ability to clear any page of this display and to type over previous messages.

F.11.44. Computer system Configuration and Monitoring Displays

Graphic and tabular displays shall be provided that allow the user to:

a. Monitor and revise the configuration of the computer system
b. Monitor the system's resource utilization statistics

F.11.45. RTU/ FRTU/FPI Communication Channel Monitoring and Control Display

This display shall show information on the status of the system's communication interface devices (including communication channels), the accessibility of each RTU/FRTU/FPI in a graphical form. The user shall be able to Enable/Disable any communication channel from this display.

F.11.46. SCADA/DMS Application Program Displays

Application program displays shall be provided to satisfy the user interface requirements of the system functions stated throughout this Specification. Application program displays shall be based on a standard user interface design across all applications to provide a common look and feel. The application's information shall be presented in such a way as to facilitate user operations. The required displays for all DMS Applications, as defined in Chapter 2 shall also be made available to the user.

F.11.47. GIS integration

The SCADA/DMS-OMS dynamic distribution network with GIS land base at the back ground shall be available for navigation. Operator shall be able to perform all functions & have features as envisaged in the specification. Suitable GIS adaptor shall be provided to import the distribution network model & GIS information from GIS system. Refer other GIS details as mentioned in chapter 1 &2 of this section.

Help Displays : Help displays shall be provided to aid the user in interpreting displayed information and to guide the user through a data entry or control procedure. Help displays shall be provided for each display that is provided with the system. Each display shall have a prominent cursor target that the user can select to request the associated help display. For standard displays, software aids (such as context sensitivity) shall be used to present pertinent help information in an expeditious manner. A programmer shall be allowed to modify and create help displays.

G. PROJECT MANAGEMENT

G.1. Project Management

The Contractor shall assign a project manager with the authority to make commitments and decisions that are binding on the Contractor. <PFCCL> will designate a Nodal officer to coordinate all <PFCCL and OPTCL> project activities. All communications between <PFCCL/OPTCL> and the Contractor shall be coordinated through the project managers/ nodal officer. The project managers shall also be responsible for all communications between other members of the project staffs including sub-contractor, if any.

G.2. Project Schedule

The bidder shall submit a preliminary project implementation schedule along with the bid. The detail project implementation schedule shall be submitted by the Contractor after award for <PFCCL's and OPTCL's> approval, which shall include at least the following activities:

a) Site Survey
b) Documents, Data Requirement Sheet, Drawing submission and approval
c) Type Testing Schedule
d) Hardware purchases, development/manufacturing and integration
e) Dispatch Schedule
f) Receipt, Storage, Installation & Field update schedule
g) Factory & Site Testing Schedule
h) Training schedule
i) Field trial run schedule

The project implementation schedule shall include the estimated period for completion and its linkage with other activities. The Project implementation schedule shall also contain <PFCCL and OPTCL> activities as required by the Contractor to complete the project.

G.3. Progress Report

A progress report shall be prepared by the Contractor for each month against the activities listed in the project schedule. The report shall be made available to <PFCCL&OPTCL> on a monthly basis, e.g., the 10th day of each month. The progress report shall include all the completed, ongoing and scheduled activities and transmittals issued and received for the month.

G.4. Transmittals

Every document, letter, progress report, change order, and any other written transmissions exchanged between the Contractor and <PFCCL/OPTCL> shall be assigned a unique transmittal number. The Contractor shall maintain a correspondence index and assign transmittal numbers consecutively for all Contractor documents. <PFCCL/OPTCL> will maintain a similar correspondence numbering scheme identifying documents and correspondence that <PFCCL/OPTCL> initiates.

G.5. Review Meeting

Progress meetings shall be scheduled by the <PFCCL/OPTCL> and attended by the Contractor each reporting period to review progress of the project. Progress meetings shall be used to review the progress report, written correspondence exchanged since the last meeting, and open action items.

The Contractor shall also attend technical meetings as and when required by <PFCCL> to discuss technical aspects of the project and to review <PFCCL/ OPTCL> comments on documents. When appropriate, these technical meetings shall be conducted as extensions to the progress meetings.

G.6. Document Review and Approval Rights

To ensure that the proposed systems conform to the specific provisions and general intent of the Specification, the Contractor shall submit documentation describing the systems to the <PFCCL and OPTCL> for review and approval.

The <PFCCL> will respond with written comments to the Contractor within thirty (30) calendar days after receipt of the documents. Documents requiring correction must be resubmitted by the Contractor to the <PFCCL> within thirty (30) calendar days. The <PFCCL> will respond to resubmitted documents within fifteen (15) calendar days after receipt of the document. No implementation schedule relief is to be implied for documents requiring correction and resubmission to the <PFCCL>.

The <PFCCL> shall have the right to require the Contractor to make any necessary documentation changes at no additional cost to the <PFCCL> to achieve conformance with the Specification.

Any purchasing, manufacturing, or programming implementation initiated prior to written the <PFCCL/OPTCL> approval of the relevant documents or drawings shall be performed at the Contractor risk. Review and approval by the <PFCCL/OPTCL> shall not relieve the Contractor of its overall responsibilities to satisfy system functions and performance requirements in accordance with the Specification.

To help the <PFCCL/OPTCL> manage the review and approval of documents during any given period, the Contractor shall stagger the release of documents over the time allocated in the project schedule. The number and size of documents shall be factored into the document release schedule. At any time, no more than five (5) documents shall be submitted to the <PFCCL/OPTCL> for review and approval.

H. DOCUMENT REQUIREMENTS

H.1. General

To ensure that the proposed systems conform to the specific provisions and general intent of the Specification, the Contractor shall submit documentation to <PFCCL> describing the systems for review and approval. Further the Contractor shall also submit the drawings / documents for all the hardware & software required for site installation, testing and commissioning and thereafter operation of the system. The Contractor shall obtain approval of <PFCCL/OPTCL> for the relevant document at each stage before proceeding for purchase, manufacturing, system deployment, factory testing, erection, site testing, training etc.

H.2. Instructions

Documents shall have unique identification No. and every revision shall be mentioned. The Contractor shall submit three (3) hard copies of each document/drawing for <PFCCL/OPTCL's> review and approval along with soft copy with each submission. After approval two (2) sets of all the documents shall be submitted as final documentation. Any changes observed during field implementation shall be incorporated in the as-built drawing and two copies of same shall be submitted to <PFCCL/OPTCL> on electronic media in pdf format.

The Contractor shall also supply two (2) sets of Technical User manuals/guides/O&M manuals/manufacturers catalogues for all the hardware & software supplied under the contract. The user manual shall at minimum include the principle of operation, block diagrams, troubleshooting and diagnostic and maintenance procedures. Considering all the components of the system the following documents/drawings shall be required under the system.

H.3. Hardware Documentation Requirements

The following document shall be submitted as applicable for the subsystem.

1 System description documents (Overview)
2 Data requirement sheets for all items
3 Functional description document
4 Database documents
5 Drawings/Documents for manufacturing/assembly of the equipment/system
6 Drawings/Documents for installation of the equipment/system at site
7 Installation Progress Document: Including documentation of date of installation, make and meter ID of existing replaced meter, meter ID of new meter, consumer account number, GPS coordinates, unmetered connection, existing meter status (OK, failed, meter tampering) , line theft, etc. Where applicable contractor may, for recordkeeping, take photographs/ videos of installation site on approval from <OPTCL>
8 Software description/design documents for each module
9 Factory test procedure and report
10 Manuals for each equipment
11 System configuration parameter
12 Site testing procedure and report
13 Training documents
14 System administrator documents
15 User guide
16 Software licenses
17 Type test reports
18 Cable sizing calculations
19 Inventory of the hardware
20 General and internal arrangement drawing of panels indicating modules, components location etc.

21 Installation drawing
22 Schematic drawing

H.4. Software Documentation Requirements

The documents to be submitted shall include the following information:

11.4.1 Software Inventory

An inventory of all software shall be maintained by the Contractor. The Contractor shall submit the following inventory lists: the preliminary inventory list at the time of the Functional Description document approval, an updated inventory list immediately prior to the start of the FAT, and the final inventory list at the time of system commissioning. The inventory shall include the name of each program, a cross reference to pertinent Contractor documents, language and libraries used, and an indication of whether the program is to be standard, modified, or custom.

11.4.2 Functional Description

Functional description documentation shall be provided for each function described in this specification. It shall include the following information for each function:

a) Introduction describing the purpose of the function with references to other documentation to aid the reader's understanding of the functions performed.
b) Performance requirements that describe the execution periodicity and the tuning parameters that control or limit the capabilities of the software.
c) Complete description of the operation, data and logic interfaces with other functions.
d) Sample displays where applicable.

11.4.3 Software Design

Software design documentation shall be provided for each function before the Factory Acceptance Test. It shall include detailed descriptions of the following items:

a) The overall organization and architecture of the software logic such as a breakout of the software into software modules.
b) Mathematical algorithms and formulae.
c) Complete description of the algorithms, operation and the data and logic interfaces with other functions.
d) Data dictionary in which the following (as applicable) information for each data item in tables, file, and array is provided: (1) Name (2) Purpose, (3) Location, (4) Length of data item, and (5) Initialization.
e) Databases internal and external to the software, along with a description of all inputs required and the output produced by the software modules.
f) Interfaces with other software modules.
g) Design limitations such as field length and the maximum quantity of data items that can be processed.

11.4.4 Database Documentation

Database documentation shall describe the structure of the database. The documentation shall define the individual elements (files, records, fields, and tables) and their interrelationships. Portions of the database developed specifically for Owner's systems shall be identified.

Documentation shall also be provided that instructs the user in the preparation of data to be used for the databases, including:

a) The overall organization of input records
b) The format of each data record
c) Each data field and the valid entries pertaining to the fields.

Sufficient database documentation shall be provided to enable the database to be updated or regenerated when inputs are changed and added, programs are modified, and new programs are added.

11.4.5 User Documentation

User documentation shall contain detailed operating instructions and procedures. Instructions and procedures shall be explained step-by-step with an explanation of how each step is performed, which parameters can be adjusted, and the effects obtained by varying each parameter. Additionally, the user documentation shall describe:

a) All user guidance and error messages, along with the steps necessary to recover from errors
b) The user interface including displays and keyboard operations used to control, review the input and output produced by the function. All displays relevant to the function shall be included along with a description of each dynamic display field.
c) Alarms and messages issued by the function and the conditions under which they are generated
d) Procedures to be followed for computer system restarts, failures, and failovers.

11.4.6 System Administration Documentation

System administration documentation shall be provided to guide <PFCCL/OPTCL> personnel in the operation and procedures required to generate and update the systems, including system software, database, application software and other elements of the systems. System administration documents shall be provided for the following items:

e) Network communications management
a) Processor configuration
b) System performance monitoring
c) System restart/failover management and diagnostic procedures
d) System generation and management
e) Database generation and management
f) Display generation and management
g) Report generation and management
h) Diagnostic programs
i) Software utilities
j) Software maintenance
k) Application software parameters and tuning guides
l) Web administration
m) Other Contractor supplied system software not included above.

H.5. Test Documentation

Documentation for all factory, field and availability tests shall be provided.

H.6. Training Documentation

Training documentation shall be provided for all courses in accordance with the requirements.

I. TRAINING REQUIREMENTS

I.1. General

General requirement for training to be imparted is as follows:

A.) Training shall be conducted by Contractor personnel who are experienced instructors and speak understandable English.

B.) The contractor shall provide training to various user groups nominated by <PFCCL/OPTCL> .The bidder shall provide the Training Approach in the response

C.) All necessary training material shall be provided by the Contractor. Each trainee shall receive individual copies of documents used for training. Training material shall be organized by functional process that will serve as the training documentation for a particular functional area.

D.) Training materials, including the documents provided to the trainees as well as handouts, shall become the property of <PFCCL/OPTCL>. <PFCCL/OPTCL> reserves the right to copy such materials, but for in-house use only.

E.) For all trainings the travel expenses will be borne by <PFCCL>.

F.) The Contractor shall quote training prices individually for each of the courses.

G.) The schedule, location, detailed contents, for each course shall be finalized during detail engineering. The number of participants in the training program may undergo change. However, all the training courses shall preferably be conducted in single batch.

H.) The training will consist of a curriculum of courses to address the issues of system operation, business-wide application, changed business processes and general use of the new system.

I.) Representatives from the contractor, <PFCCL's> project management teams will be involved throughout in the development of training strategy, training material design and development, standards and training delivery to ensure that change management issues are incorporated, and that training strategies and materials are aligned to the requirements of the project and as business-specific as possible.

J.) The contractor is required to quote on per day basis for Training

K.) <PFCCL>will have the option to cancel any or all training. In the case of cancellation, the rate quoted against the respective training will not be paid to the Contractor.

. The training modules shall include but not limited to –

- AMI Administration & Configuration
- AMI Installation and Trouble-Shooting
- Application Management
- Application Data Analysis

The contractor shall be required to organize following training for the <PFCCL/OPTCL> personnel: -

Professional Training - This is the training for the core group of implementation team of the <OPTCL> and <OPTCL/PFCCL>. This team will comprise of members from all the Business Functions and IT sections. Each member would be trained in the relevant function/ module. This Training would be required to be given to approximately <X>personnel. It is the responsibility of contractor to deliver this training. Standard curriculum, designed and agreed by the <OPTCL/PFCCL> for hardware, software and network preferably shall be arranged by the contractor for each group. The <PFCCL> will prefer if a portion of the training is conducted on-site.

End User Training - The contractor will provide training to the owner's team on a "Train the Trainer" basis. The <OPTCL's> team so trained will then train all of the <OPTCL's> end users. It is estimated that this training will require around <X>groups, with each group comprising of around <X>persons. These training sessions will be required to be conducted at any of the sites. The recommended training material can be in paper / electronic media with courses on Business Process Automation software

fundamentals, business process overview, job activity training, and delivery options being on-line, CBTs, instructor led class rooms, etc.

In addition two Engineer's from OPTCL and <PFCCL> shall be stationed at the contractor's works during development/customization of solution as per tender. The deputed OPTCL/ <PFCCL> engineers shall be involved with the project till its completion.

J. SERVICE LEVEL AGREEMENT

Sl No	SLA Parameters	SLA Deductions
1	**During installation, commissioning and stabilization period (**Up to 24 months from the date of issuance of LoA). 1st Bill can be submitted after availability of billing data through AMI.	**No Deduction**
2	**After installation, commissioning and stabilization period (**Beyond 24 months from the date of issuance of LoA).	
2.1	Vendor will have to ensure 100% billing data either through AMI or through CMRI uploading.	**Deduction of 1% of the billed amount will be done for every 1% non-availability of billing data.** (e.g: for 98% of total billing data availability 2% deduction of bill amount will be done)
2.2	From Month 25 to Month 30 up to 90% availability of AMI Billing data (within 3 days of billing reset date)	No Deduction
2.3	From Month 31 to Month 36: up to 95% availability of AMI Billing data(within 3 days of billing reset date)	No Deduction
2.4	Due to non-compliance on above points from 2.2 to 2.4	**Deduction of 2% of the amount invoiced to DISCOM by vendor for every 1% reduction in AMI Billing data** (e.g: for 80% AMI billing data availability in 31st month, 20% deduction of bill amount will be done)
3	Remote Re-connection and Disconnection (within 10 minutes from action performed).	
3.1	Then after every failure of remote disconnection or reconnection	Rs. 100 per meter per failed reconnection/ disconnection
4	Availability of analytical data (Load Profile Data, Instantaneous, Midnight data, Critical Events Alarms and All event as Info is considered as analytical data)	
4.1	95% availability of analytical data	No deduction
4.2	Then after non availability of analytical data	Rs. 10 per meter per day
Note: 1. Cases where penalty has already been levied in Sr. No. 1 and 2 will not be further penalised for clause at Sr. No. 3 and 4 **2.** In case the reason of non-compliance is not attributable to SGIA such as Meter Tampering (use of jammers or other tamper devices), Premises Locked (CMRI cases), Meter not accessible (CMRI cases) etc. and the case is timely reported by SGIA to DISCOM with proper evidence, the penalty will not be levied.		

K. Operation & Maintenance

K.1. Advanced Metering Infrastructure (AMI)

The SGIA shall be required to provide the services so as to manage entire AMI system installed & commissioned by SGIA for the DISCOM to realize their desired business objectives.

System Management Services shall be provided by SGIA in order that maximum uptime and performance levels of installed AMI systems is ensured. As such, Implementing Partner is expected to provide services with performance levels meeting or exceeding those mentioned in Service Level Agreement (SLA).

The O&M shall start immediately after the completion implementation period and acceptance by the user. The O&M would, include following services:

K.1.1. Operation Services:

a. Smart Metering Control Operation
b. Meter reading of Non-communicating meters
c. Interface management with billing and other applications
d. Data analysis
e. Energy audit
f. Remote disconnection / reconnection
g. Review, analysis & validation of AMI Project results
h. Complaint Management / Handling
i. Management AMI solution system
j. Performance report generation

K.1.2. Meter Installation Administration, Maintenance and Management Services

SGIA shall effectively support and maintain the AMI system and will include:

a. Installation, replacement & maintenance of Faulty ANI Devices including Meters
b. OS and firmware upgrade administration including updates and patches to ensure that the system is properly updated at any given time
c. Installation and Re-installation of the meters in the event of crash/ failure.
d. Regular analysis of events and logs generated in all the sub-systems to identify vulnerabilities. Action shall be taken in accordance with the results of the log analysis
e. Provide integration and user support

K.1.3. Network Services

SGIA shall ensure continuous operation and up keep of the RF / GPRS Services. The services to be provided will include:

a. Ensuring that the network is steady and available24x7x365 as per the prescribed SLAs
b. Attending to and facilitate resolving of network failures and snags including dark spot
c. Installation and Re-installation of the NIC and SIM Cards.
d. Tuning of various parameters to optimize performance and to ensure industry standard QoS with customization is being delivered.

K.1.4. AMI Application Services

SGIA shall provide Application Development and Maintenance / Support Services on an ongoing basis, especially in response to integration, data exchange along with requests for changes in the Applications through an AMC/ATS. Support in the area of software development and maintenance shall include:

a) Maintaining usage of deployed AMI Applications so as to ensure its effective day to day to operational usage. This includes support maintenance of all the Application modules along with system software
b) SGIA shall debug and fix the operational problems, perform error handling while running the Application during the project period
c) SGIA shallprovidehands-onassistancetotheuserstoresolveanyoperationaldoubts as and when needed while the Application is in operation
d) SGIA shall designate resource including Team Lead who will maintain and manage the deployed applications
e) SGIA shall be responsible for Integration of deployed applications during the project period with other applications /systems.
f) SGIA shall document all the changes incorporated in the application software and also improves the documentation of existing user / system reference manuals of different modules wherever it is necessary and possible

K.1.5. Patch and Configuration Management

Manage the instances of storage, compute instances, and RF / GPRS network environments. This includes Agency- owned and installed operating systems and other system software. SGIA is also responsible for managing specific controls relating to shared touch points within the security authorization boundary, such as establishing customized security control solutions. Examples include, but are not limited to, configuration and patch management, vulnerability scanning, disaster recovery ,and protecting data in transit and at rest, host firewall management,managingcredentials,identityandaccessmanagement,andmanagingnetworkconfigurations.

K.1.6. Monitoring Performance and Service Levels

Provide and implement tools and processes for monitoring the availability of assigned applications, responding to system outages with troubleshooting activities designed to identify and mitigate operational issues:

a. Reviewing the service level reports, monitoring the service levels and identifying any deviations from the agreed service levels.
b. Monitoring of service levels, including availability, uptime, performance, application specific parameters, e.g. for triggering elasticity, request rates, number of users connected to a service
c. Detecting and reporting service level agreement infringements
d. Monitoring of performance, resource utilization and other events such as failure of service, degraded service, availability of the network, storage, database systems, operating Systems, applications, including API access within the cloud SGIA ’s boundary.

K.1.7. Business Continuity Services

Provide business continuity services in case the primary site becomes unavailable

K.1.8. Support for Third Party Audits

Enable the logs and monitoring as required to support for third party audits.

K.1.9. Storage and Backup management

The SGIA shall perform backup as per the requirement of the DISCOM. This will include installation of backup software, managing the tape library, regular backup and restore operations and assuring security of the media through appropriate access control. In addition, the SGIA shall also manage scheduled data replication. The activities shall include:

a. Backup of operating system, database and application shall be performed as per stipulated

policies of the DISCOM at the data centre premises. The SGIA shall provide required tools for undertaking these activities.

b. Monitor and enhance the performance of scheduled backups, schedule regular testing of backups and ensure adherence to related retention policies
c. Ensure prompt execution of on-demand backups of volumes, files and database applications whenever requiredbytheDISCOMorincaseofupgradesandconfigurationchangestothesystem
d. Ensuring failed backups are restarted and completed successfully within the back up cycle
e. Real-time monitoring, log maintenance and reporting of backup status on a regular basis. The administrators shall ensure prompt problem resolution in case of failures in the back up processes
f. The administrators shall undertake media management tasks, including, but not limited to, tagging, cross- referencing, storing, logging, testing, and vaulting in fireproof cabinets (on site and off site).
g. The SGIA shall ensure the physical security of the media stored in cabinets.
h. The SGIA shall also ensure that a 24 x 7 support for file, database and volume restoration requests is available at the datacentre.
i. The SGIA shall also provide sufficient media (tape library) for daily, weekly and additional backups for the duration of the contract
j. Maintaining inventory of onsite tapes
k. Management of storage environment to maintain performance at optimum levels
l. Management of the storage solution including, but not limited to, management of space, volume, RAID configuration, configuration and management of disk array, SAN fabric/switches, tape library etc.
m. Generation and publishing of backup reports periodically

K.1.10. Service Delivery management

SGIA shall provide detailed description for service delivery management for the complete project plan and deliverables and project management methodology.

1. Project Management
    a. SGIA will assign a Project Manager who will provide the management interface facility and has the responsibility for managing the complete service delivery during the contractual arrangement between DISCOM and the SGIA .
    b. ProjectManagerwillberesponsibleforpreparationanddeliveryofallmonthly/weeklyreport saswell as all invoicing relating to the service being delivered.
    c. Project Manager's responsibilities shall essentially cover the following:
        i. Overall responsibility for delivery of the Statement of Work/s (SOW) and Service Level Agreement (SLA).
        ii. Act as a primary interface to DISCOM for all matters that can affect the baseline, schedule and cost of the services project.
        iii. Maintain project communications through DISCOM's Project Leader.
        iv. Provide strategic and tactical recommendations in relation to technology related issues
        v. Provide escalation to SGIA 's /DISCOMs senior management if required
        vi. Resolve deviations from the phased project plan.
        vii. Conduct regularly scheduled project status meetings.
        viii. Review and administer the Project Change Management with DISCOM Project Leader.
        ix. Identify and resolve problems and issues together with DISCOMP Project Leader.
        x. Responsible for preparation and delivery of all weekly/quarterly/monthly reports as well as all invoicing relating to the services being delivered

K.1.11. Asset and Inventory Management of AMI Solution

a. SGIA shall provide asset-tracking services for the AMI assets created for the DISCOMs SGIA shall create/ maintain the AMI solution asset database by recording information like configuration details, serial number, asset code, location details, warranty and AMC.
b. The database shall be regularly updated by the SGIA . The updating shall be required due to new installations, up gradations of systems, change of location of systems, discarding of systems, sending of components for repairs etc.
c. The SGIA at anytime must be able to display to DISCOM latest level of AMI assets & inventories.
d. Provide asset verification at least once a year in presence of DISCOMs personnel
e. SGIA shall provide regular MIS based on above to DISCOM regarding need of new AMI solution components considering appropriate procurement time. The procurements shall be done by DISCOMs.
f. Prior to completion of contract period, SGIA shall hand over all assets along with report of all services to new SGIA / DISCOM staff.

K.1.12. Antivirus Management

This Service includes virus detection and eradication, logon administration and synchronization across servers, and support for required security classifications.

K.1.13. Server Administration Management

SGIA shall provide:

a. The server administration and monitoring service to keep servers stable, operating efficiently and reliably.
b. Provide administrative support for user registration, creating and maintaining user profiles, granting user access and authorization, providing ongoing user password support, and providing administrative support for print, file, and directory, services.

SGIA 's responsibilities shall include the below but are not limited to:

a. Setting up and configuring servers
b. Installation of the server operating system and operating system utilities
c. reinstallation on event of system crash/failures
d. OS Administration for IT system
e. Manage Operating system, file system and configuration
f. Ensure proper configuration of server parameters, operating systems administration and tuning
g. Regularly monitor and maintain a log of the performance monitoring of servers including but not limited to monitoring CPU, disk space, memory utilization, I/O utilization, etc.
h. Regular analysis of events and logs
i. Apply OS Patches and updates
j. Monitor & verify logs files and periodically clean up logfiles
k. Ensureproperrunningofallcriticalservicesontheservers.Scheduleandoptimizetheseservices
l. Maintain lists of all system files, root directories and volumes
m. Resolving all server related problems
n. Escalating unresolved problems to ensure resolution as per the agreed SLAs
o. Responsible for periodic health check of the systems, troubleshooting problems, analysing and implementing rectification measures
p. Logical access control of user and groups on system
q. Responsible for managing uptime of servers as per SLAs

K.1.14. Database Administration Services

SGIA shall:

a. Undertake end-to-end management of database on an ongoing basis to ensure smooth functioning of the same.
b. Undertake tasks including managing changes to database schemes, diskspace, storage, and user roles.
c. Setting and tuning system parameters
d. Building appropriate indexes, specifying large enough buffers and caches, aligning the database implementation with IT infrastructure, monitoring databases and applications, reorganizing databases, etc.
e. Manage database upgrade or patch upgrade as and when required with minimal Downtime

K.1.15. Incident Management

The SGIA must have:

a. Ability to create an incident record to document a deviation from an expected standard of operation
b. Ability to create other ticket from the incident, if resolving the incident involves creating a service request, problem or workorder
c. Incident could be created automatically from sources such as email, system-monitoring tools
d. Ability to have ticket template containing data that agent can automatically insert in common, high-volume records. Instead of manually entering standard information each time, Implementing Partner can apply a template that contains information such as owner, service group, service, classification, internal priority, activities, labor requirements, and activity owners
e. The template can add the following information, but can be modified to include: Priority, Owner or Owner Group, Service Group or Service, Classification; for Activities: Activity, Sequence, Jo border, Site, Organization, Description, Owner or Owner Group, Priority, Vendor, and Classification
f. Ability to assign ownership of an incident either to a person or a person group who is responsible for managing the work associated with that record
g. Ability to assign ownership via workflow or an escalation process
h. Ability to associate an asset for an Incident record, if the issue you are reporting or working on involves an asset
i. Ability to view a list of related records and view the work and communication logs for all related records on one screen, on the global record
j. Ability to create a service request from an incident with a relationship between the two records
k. Ability to create a Problem from Incident application to record an unknown, underlying cause of one or more issues.
l. Ability to create a release in the Incident application when resolving the Incident involves releasing a set of bundled changes to users.
m. Ability to relationships between Incidents
n. Ability to identify a global incident, which is the root cause of many other issues or that is something affecting many users
o. Ability to automatically assign one or more SLAs via Workflow or Escalation process based on SLA's criteria
p. Ability to apply an incident template which contains activities that can be viewed and edited
q. Ability to find and attach Solution record containing information on resolving to an Incident record
r. Ability to record Solution containing information on the symptom, cause, and resolution

s. Ability to create and submit a draft solution from the Incident application screen which an agent can approve the solution for general use later
t. The communication log stores inbound and outbound messages and attachments sent between users and agents
u. Ability to view communication entries associated with a record
v. Ability to use a communication template to fill in default data

K.1.16. Preventive Maintenance

The preventive maintenance activities shall be performed by the SGIA to keep the system running at optimum level by diagnosis and rectification of all AMI component failures and would broadly include:

a. Repair / replacement of defective equipment: The SGIA shall be responsible for repair/replacement of all the components of the AMI system including meter.
b. Configuration routine checking as part of a preventive maintenance which would include checking of functionality AMI system software.
c. Monitoring of the performance of the system and doing necessary tuning for optimum performance to accommodate any changes such as addition of new components.
d. Providing all necessary assistance to DISCOM for addition and modification of database and user interface & consumer portal displays and Database sizing activities.
e. Take Backup of the system at regular interval
f. Restoration of the systems upon its failure and to restore the functioning of the various systems at the Control Centre.

K.1.17. Integration of new Smart Meters

All future services, protocol emulations and configuration support for integration of smart meters/ web services, integration with other offline applications etc. shall be the responsibility of SGIA and shall be part of the maintenance charges.

K.2. SCADA/DMS-OMS

K.2.1. OPERATION

K.2.1.1. 24*7 Operation of SCADA/DMS Control Centre

a. Control and monitor remotely all kind of field activities regarding telemetering
b. Provide remote assistance to field staff about sudden breakdowns/tripping.
c. Improve System Reliability and reduce Power Restoration Time.
d. Enable faster Identification of faults.
e. Minimize “Un-Served Energy”.
f. Facilitate Technical Loss reduction.
g. Improve Consumer Satisfaction Level.
h. Assistance for power scheduling and creation of various analytical reports.
i. Carry out call center support activities from the control room.
j. Load forecasting, load scheduling and load shedding, Load Management, system monitoring and control.
k. System Monitoring and Control
l. Distribution shutdown (Planned & Emergency) & Notification approval (BY USING PTW
m. GUIDELINES)
n. Integration with Transmission Points and other areas in the utility
o. Ensuring Safety of working person and equipment during real-time operation
p. Network correction in SCADA/DMS system
q. Operational co-ordination with transmission, exchange point data and other co-ordination with utility personal for operation and load management activity.

r. Coordination for System Alteration
s. Calculation of reliability indices such as SAIDI and SAIFI
t. Alarm Management, Outage Management

K.2.1.2. Documentation of Standard Operating procedure for Power System Operations

a. Permit to work guideline creation
b. Reengineering of business processes
c. Redesign of Standard Operating Procedures
d. Preparation of Operation Safety Manual

K.2.1.3. Capacity building of Operational Staff

a. Operation training on SCADA/DMS systems
b. Operation training of SCADA enabling component like RMU, Sectionalizer and auto-recloser
c. Training for protection co-ordination

K.2.2. MAINTENANCE

The maintenance of the SCADA-DMS System under Operation and Maintenance (O&M) period shall be comprehensive, as set forth herein, in nature and would broadly include but not be limited to diagnosis and rectification of the hardware and software failures. The Scope includes:

a. Co-ordination with equipment supplier for Repair/ replacement of defective equipment's
b. Configuration of the replaced hardware/software, periodic routine checking as part of a preventive maintenance program which would include checking of functionality of hardware and software
c. Services to bring up any or all SCADA-DMS systems upon its failure and to restore the functioning of SCADA-DMS system including Control Centre etc.
d. Database sizing and CFE card addition for new RTUs/FRTUs
e. The support for the RTU's /FRTUs
f. All Software modules under the SCADA-DMS System and the associated Hardware supplied under this project.
g. Routine works like database building, addition of analog and status points and other such day-to-day operational activity would primarily be the responsibility of Utility and in case of any difficulty in this regard the same shall be referred to the SGIA for support.

K.2.2.1. Hours of Cover

The SGIA's on-site support standard hours of service, the timings for Emergency Software Support would be 24 hours a day, 7 days a week throughout the year (i.e. 24x365). At least three Engineers including Site Manager along with one on-site support personnel for Hardware and one on-site personnel for Software shall be deployed at each control centre. The support personnel so deployed shall be qualified personnel having experience in the delivered SCADA/DMS system.

The SGIA shall be responsible for 24*7*365 management of all the systems as per scope of work with services rendered at least as per Service Level Agreement between utility & SGIA. The Scope does not include management of physical security for access to the said facilities. The following facilities will be provided at the start of contract to SGIS by Utility for carrying out the O&M responsibilities:

a. Appropriately secured lockable storage/setup area
b. Sufficient Sitting/office space in neat & clean environment
c. PC (other communication facilities like P&T telephone & internet facility are to be arranged by SGIA)

K.2.2.2. Service Delivery Management

SGIA shall provide detailed description for service delivery management for the complete project including transition plan and deliverables and project management methodology.

Project Management

SGIS will assign a Project Manager for the entire State who will provide the management interface facility and has the responsibility for managing the complete service delivery during the contractual arrangement between utility and the SGIA. Project Manager will be responsible for preparation and delivery of all monthly/weekly reports as well as all invoicing relating to the service being delivered. Project Manager's responsibilities should essentially cover the following:

a. Overall responsibility for delivery of the Statement of Work/s (SOW)
b. Act as a primary interface to Utility for all matters that can affect the baseline, schedule and cost of the services project.
c. Maintain project communications through Utility's Project Leader.
d. Provide strategic and tactical recommendations in relation to technology related issues
e. Provide escalation to SGIA's senior management if required
f. Resolve deviations from the phased project plan.
g. Conduct regularly scheduled project status meetings.
h. Review and administer the Project Change Control Procedure with utility Project Leader.
i. Identify and resolve problems and issues together with utility Project Leader.
j. Responsible for preparation and delivery of all monthly reports as well as all invoicing relating to the services being delivered.
k. Fault Detection and Notification: The SGIA shall diagnose problems that could arise as part of the LAN/WAN network. These include connectivity problems due to failures in communication transport links, routing configuration points, or from software bugs etc.
l. Fault Isolation and Resolution: All faults that have been identified need to be isolated and rectified appropriately. The resolution measures undertaken by the SGIA and results produced accordingly shall be documented in the report.
m. Carrier Coordination: Carrier Coordination implies providing a single point of contact to resolve network related problems involving carrier circuits, whether equipment or circuit related. When a problem is diagnosed because of a WAN circuit, the SGIA must coordinate with the corresponding carrier to test and restore the circuit. The SGIA must take the responsibility and ensure that the problem is resolved.
n. Hardware/Software Maintenance and Monitoring: This would include problem determination, configuration issues, and hardware and software fault reporting and resolution. All such issues would need to be recorded and rectified.
o. 24x7 Network Monitoring and reporting: The SGIA shall monitor the network on a continuous basis using the NMS and submit reports on a monthly basis with instances from the NMS system. System performance is to be monitored independently by the SGIA and a monthly report mentioning Service up time etc. is to be submitted to Utility. The report shall include:
    i. Network configuration changes
    ii. Network Performance Management including bandwidth availability and Bandwidth utilization
    iii. Network uptime
    iv. Link uptime
    v. Network equipment health check report
    vi. Resource utilization and Faults in network
    vii. Link wise Latency report (both one way and round trip) times.

viii. Historical reporting for generation of on-demand and scheduled reports of Business Service related metrics with capabilities for customization of the report presentation.

ix. Generate SLA violation alarms to notify whenever an agreement is violated or is in danger of being violated.

x. Any other reports/format other than the above mentioned reports required by utility

Install, Moves, Adds, Changes (IMAC) Services

This Service provides for the scheduling and performance of install, move, ads, and change activities for Hardware and Software. Definitions of these components are as follows:

Install: Installation of desktop machines/workstations, servers, peripheral equipment, and network-attached peripheral equipment, which form part of the existing SCADA/DMS System (new equipment needs to be procured by the Utility).

Move: Movement of desktop machines/workstations, servers, peripheral equipment, and network-attached peripheral equipment.

Add: Installation of additional hardware /software after initial delivery

Change: Upgrade to or modification of existing hardware or software on desktop/workstations and servers etc.

Requests for IMAC shall be prepared by SGIA depending on customer/ system requirements & shall be approved by utility. Utility shall formulate guidelines for IMAC & communicate it to SGIA. All procurements shall be done by utility.

Contract Management Services

As part of this activity, for efficient and effective warranty implementation, the SGIA's team will:

- Manage the vendors for escalations on support
- Logging calls and co-ordination with vendors
- Vendor SLA tracking
- Management of assets sent for repair
- Maintain database of the various vendors with details like contact person, Tel. Nos., response time and resolution time commitments. Log calls with vendors, Coordinate and follow up with the vendors and get the necessary items exchanged.
- Analyse the performance of the Vendor periodically (Quarterly basis)
- Provide MIS to utility regarding tenure of completion of warranty/AMC with outside vendors for software, hardware & networks maintenance in order that utility may take necessary action for renewal of warranty/AMC. SGIA shall also provide MIS regarding performance of said vendors during existing warranty/AMC.

Since during initial five years, warranty is in scope of bidder there will be no AMC for SCADA/DMS system. During such period, SGIA has to interact with such vendors for maintenance services and spares.

After warranty period, if required Utility can award the suitable AMC and SGIA has to interact with vendors as selected by utility for providing AMC for the said system on mutually agreed terms & conditions.

K.2.2.3. Backup and Restore Management

SGIA will perform backup and restore management and shall ensure:

- Backup and restore of data in accordance to defined process / procedure.
- 24 x 7 support for database restoration requests
- Maintenance and Upgrade of infrastructure and/or software as and when needed.
- Performance analysis of infrastructure and rework of backup schedule for optimum utilization.
- Generation and publishing of backup reports periodically.
- Maintaining inventory of onsite tapes.
- Forecasting tape requirements for backup.
- Ensuring failed backups are restarted and completed successfully within the backup cycle.
- Monitor and enhance the performance of scheduled backups
- Real-time monitoring, log maintenance and reporting of backup status on a regular basis.
- Management of storage environment to maintain performance at optimum levels.
- Periodic Restoration Testing of the Backup
- Periodic Browsing of the Backup Media
- Management of the storage solution including, but not limited to, management of space, volume, RAID configuration, configuration and management of disk array etc.,
- Interacting with Process Owners in developing / maintaining Backup & Restoration Policies / Procedures
- To provide MIS reports as per agreement

K.2.2.4. Restoration of Control Centre in case of failure

The SGIA shall ensure that all the relevant data is transferred from control centre at regular frequency to Data Recovery Centre (DR) which is required for restoration of Control Centre in case of complete failure of Control centre.

The SGIA shall carry out system build in order to build the SCADA/DMS system at Control centre from scratch utilizing DR Centre.

K.2.2.5. Performance Monitoring and Reporting

Regularly monitor and maintain a log of the performance monitoring of servers including but not limited to monitoring CPU, disk space, memory utilization, I/O utilization, Central Storage etc.

Regular analysis of events and logs generated in all the sub systems including but not limited to servers, operating systems, databases, applications etc. The system administrators shall also ensure that the logs are backed up and truncated at regular intervals.

The administrators shall undertake actions in accordance with the results of the log analysis to ensure that the bottlenecks in the infrastructure are identified and fine-tuning is done for optimal performance.

Reporting to utility for all system performance monitoring.

K.2.2.6. Service Management Tools

The SGIA must adhere to well-defined processes and procedures to deliver consistent quality services throughout its contractual period. Any hardware/software to meet the requirements under this section must be provided by the SGIA. The SGIA is expected to have the following system management controls in place:

Availability Management

The SGIA must define the processes/procedures which ensure the service delivery as per the required SLAs or exceed it. It should cover various equipments such as all the servers, networks, switches, routers, Modems & other site specific services, and the critical services and their supporting hardware, and software components, as defined in scope of work. Industry standard SLA management tools should be deployed and shall have following essential features:

- Ability to create an escalation for an SLA.
- Ability to workflow the SLAs.
- Ability to create new action types, if needed.
- Ability to define sets of actions that are grouped together in a specific sequence.
- Ability to associate an escalation point with one or more actions through the action group.

Security Management

The protection from unauthorized usage, detection of intrusions, reporting as required and proactive prevention actions are to be provided by the SGIA.

K.2.2.7. Support Services

Emergency Support

The severity levels are defined under clause 1.2.2.8. Emergency Support for Severity 1 issues are to be provided 24 hours a day, seven days a week. The on-call support team shall include all key technical competencies so that any aspect of a system failure can be attended. The team comprise of experienced technical staff that are skilled in troubleshooting SCADA / DMS systems. Severity 1 problems shall be reported by telephone for rapid response; target response times are defined in clause 1.2.2.9.1. The SGIA shall submit the process details to meet the above requirements along with the offer. For severity 1 problems, the key objective is to restore the system to an operational state as quickly as possible, including by a temporary workaround. Resolution of the defect may be completed during standard hours.

The Emergency Support service goal is to meet the availability targets greater than specified in this document (minimum 99% for Overall SCADA/DMS System). Resolution of problems may also be provided by an individual fix that will be installed by the SGIA at no extra cost to Utility.

Monitoring

The SGIA shall conduct the following monitoring, for the supplied SCADA/DMS System.

Error Log Monitoring

To monitor the performance of SCADA/DMS system on a bi-weekly basis, the SGIA shall review the following, analyse the results, and communicate to Utility:

- System logs for a selected day
- System history log
- Aggregate data collection
- Events Collection

During monitoring if any defect is found, the SGIA shall undertake corrective action for the same. The SGIA shall submit the process details to meet the above along with the offer.

Resource Monitoring

Resource Monitoring services comprises checking the system's major node resources, gather log data, analyse results, and advise Utility on the appropriate actions to be taken and undertake any agreed upon actions. A tool will be created to continuously collect the following information:

- CPU loading (Peak and Average)
- System error log
- Disk utilization (Peak and Average)
- Operating system error reports
- LAN utilization (Peak and Average)
- Bandwidth utilisation
- Memory utilisation (Peak and Average)

The SGIA shall submit the procedures details to meet the above along with the offer.

Support for System expansion

New RTUs, RMUs & FPIs etc per year are likely to be added to match the growing Power system. The services to be provided by the SGIA will include the Communication Front End (CFE) port/card addition/expansion, database resizing, interface addition in CFE and support for integration confirming to the IEC standards / existing application. This would not include the cost of equipments/card required for expansion.

K.2.2.8. Problem Severity Levels

The problems will be categorized as follows:

Category	Definition
Severity 1 – Urgent	Complete system failure, severe system instability, loss or failure of any major subsystem or system component such as to cause a significant adverse impact to system availability, performance, or operational capability (
Severity 2 – Serious	Degradation of services or critical functions such as to negatively impact system operation. Failure of any redundant system component such that the normal redundancy is lost, Non-availability of Man-power at control centre during working hours
Severity 3 – Minor	Any other system defect, failure, or unexpected operation
Severity 4 – General/Technical Help	Request for information, technical configuration assistance, “how to” guidance, and enhancement requests.

The details of the system under different severity level are as below:-

Severity of the system under different Severity level.

Severity-1 (Urgent support)

This support is required when there is a complete system failure, severe system instability, the loss/ failure of any major sub-system / system or its components, which may significantly impact the system availability, performance, or operational capability at Control centre. For example, loss of data to the operator due to any problem in SCADA-DMS system, loss of ICCP system (software/Hardware

related),Loss/failure of DR Centre, outages of both the CFEs attributable to any software/hardware related problem, outage of any important software functionality (on both the servers) which is required to disperse Distribution management functions, , Failure of both GPS clock and time synchronization and outage of both routers, failure of both LAN system, outage of both main and backup servers of any system, firewall would be included under this category. Initially Utility's Engineers shall attempt to restore the system. In case the system does not come up and/or the problem is not resolved then Utility's Engineer shall intimate the problem to the SGIA. Upon receiving intimation, the representative of the SGIA would immediately attend to the problem and if required, any other authorized representative the SGIA may log on to the system. The problem shall be attended by the SGIA at the earliest, within the response/Resolution time as specified in the Agreement. The SGIA shall take all steps to restore the SCADA functionality at the earliest to avoid data loss.

Severity-2

The support services not defined under Severity-1 are included under this category. Failure of one SCADA/DMS/FEP Server/ICCP server, failure of VPS, Stoppage of data collections for archiving, real time calculations, failure in Acquisition of SOE at the respective Control-Centre, outage of Real Time Network and distribution applications, and other applications are included in this category. Coverage under this severity would be outages that do not immediately cause on feeder data loss but subsequently could result into Severity-1 category outage, loss of an important subsystem that may affect the day-to-day works and loss of archived data. Failure of any redundant system component affecting the critical redundancy like loss of any one Application Processor, Router, CFE would also be included in this category. Non-availability of Man-power at control centre during working hours will also be covered under this category.

Severity-3 (Standard support)

The support services included under this category are when the outage or loss of functionality is neither an emergency nor a priority functionality as indicated in severity level 1 or 2 above. Problems like database reworking, failure of any one workstation, etc. would be covered under this Severity.

Severity-4 (General Technical Help)

Request for information, technical configuration assistance, "how to" guidance, and enhancement requests are included under this category.

K.2.2.9. <u>Response and Resolution Time</u>

This clause describes the target times within which the SGIA should respond to support requests for each category of severity. The Initial Response Time is defined as the period between the initial receipt of the support request (through approved communications channels) and the acknowledgment of the SGIA The Action Resolution Time is the period between the initial response and the SGIA delivering a solution. This period includes investigation time and consideration of alternative courses of action to remedy the situation. The Action is defined as a direct solution or a workaround.

Except for Severity Level 1, all hours and days specified are working hours only.

<u>Emergency Support Response/Resolution Time</u>

Severity	Initial Response Time	Action Resolution Time	Action

1	30 minutes	2 hours	An urgent or emergency situation requiring continuous attention from necessary support staff until system operation is restored – may be by workaround.
2	1 day	2 days	Attempt to find a solution acceptable to Utility/ Employer as quickly as practical. Resolution time is dependent on reproducibility, ability to gather data, and Utility prioritisation. Resolution may be by workaround.
3	2 days	5 days	Evaluation and action plan. Resolution time is dependent on reproducibility, ability to gather data, and Utility prioritisation. Resolution may be by workaround.
4	2 days	10 days	Report on the problem/query is to be furnished.

The SGIA shall submit the detailed format/procedure for all the activities such as Reporting time, Resolution time, Downtime etc. along with the offer.

K.2.2.10. Preventive Maintenance

The SGIA shall undertake preventive maintenance of all equipment/modules (i.e. Hardware & Software supplied under the SCADA/DMS System), under the scope of this contract, in accordance with this section. The SGIA will prepare the report as per periodicity defined below and submit the same to the Engineer-in-charge.

Activities shall include but not limited to:

- Patch Management for OS and Application Software
- Automatic update of Antivirus and firewall signatures on daily basis.
- Average and peak usage of CPU, LAN, Memory and Disk –once every month .
- Monitoring of machine with reference to error reports and logs - once every week
- Online diagnostics for servers and workstations - once every 3 months.
- Connection test of LAN cables for identifying potential loose contacts in machines, hubs and routers - once every 3 months.
- Physical hardware checks to ensure proper working of cooling fans etc.- once every 3 months.
- Physical inspection to check the machines and the panels for rat droppings, lizards or other vermin - once every 3 months,
- Cleaning and blowing for removal of dust from Servers, Workstations, CFE panels and RTUs/FRTUs etc.- once every 3 months.

Exclusions:

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

K.2.2.11. SGIA's Obligation

- In order to optimise and improve the response of the system, the SGIA may re-install the program modules after making the Utility engineer aware of the consequence (like data loss, database rebuild etc).
- Any modification of software/Operating System required to restore functionality due to hardware upgrades, patches, or arising out of a necessity to fix FPRs, would be done by the SGIA at no extra cost to Utility. Also, any software updates/upgrades released till the completion of warranty period /AMC shall be provided and installed & commissioned free of cost as per instructions from Utility.
- The SGIA shall ensure that all components (Hardware & Software) covered under five years comprehensive on-site warranty are maintained in good working condition and in case of any defect , timely replacement/repair shall be carried out so as to meet the availability requirements specified herein.
- The SGIA will submit FSR (Field Service Report) and the steps taken to solve the problem, along with details of code changes.

K.2.2.12. Responsibility of Utility

- Utility will ensure the availability of competent staff appropriately trained in the administration and use of existing SCADA/DMS systems for proper operation of the system.
- Utility shall ensure that proper Environmental conditions are maintained for the system.
- Utility shall ensure that the System is kept and operated in a proper and prudent manner and only trained Utility employees (or persons under their supervision) are allowed to operate the system.
- Utility shall provide access to the sites of installation for purposes of providing Support Services.

K.2.2.13. Responsibility matrix

The table in this clause provides a summary definition of the roles and responsibilities of the SGIA and Utility.

Legend:	?	This indicates who has primary responsibility to perform this function.
	A	This indicates who will provide assistance.

Item	Task	Utility / Employer	SGIA
0.0	PROBLEM IDENTIFICATION		
0.1	Root cause analysis to determine whether the fault is attributable to Hardware or Software.	A	?
0.2	Resolution of problems involving third party maintainer where there is uncertainty whether the root cause is hardware or software.	A	?
1.0	SOFTWARE PROBLEM RESOLUTION		
1.1	Report problem and assist with problem identification	A	?

		1.2	Provide or recommend corrections, temporary patches, workarounds or other fixes to system problems		
		1.3	Install and test corrections, temporary patches, workarounds or other fixes to system problems	A	
		2.0	ROUTINE SOFTWARE SUPPORT		
		2.1	Build and maintain database, displays and reports		A
		2.2	Perform system back-ups	A	
		2.3	Restore or reinstall software from back-ups	A	
		2.4	Monitor system logs (part of remote monitoring service)	A	
		2.5	Maintain system logs	A	
		2.6	Maintain user accounts		A
		3.0	HARDWARE PROBLEM RESOLUTION		
		3.1	Report problem and assist with defining problem		A
		3.2	Troubleshoot problem to diagnose if it is software-related or hardware-related	A	
		3.3	Identify failed component, Replace failed components in online system using parts from spares inventory	A	
		3.4	Restore operation of repaired/replaced equipment	A	
		4.0	HARDWARE SPARE PARTS		
		4.1	Manage local spares inventory	A	
		4.2	Provide appropriate facility for local storage of spares		
		4.3	Replenish local spares inventory	A	
		5.0	Integration and database work		
		5.1	CFE Card addition/Expansion	A	
		5.2	Database resizing	A	