## Chapter 1: Background of the Report

The power utilities throughout the country are moving towards smart metering/ Advanced Metering Infrastructure (AMI) in order to stay competitive, extend quality service to their consumers and facilitate renewable integration. Some of the distribution licensees in the country have already initiated smart grid pilot projects primarily to demonstrate new technological options and its effective operations. In this connection, as per the decision of the Commission in its meeting held on 27.04.2018 at OERC, a Task Force with the following members and observers was constituted on the Smart Meter implementation in the DISCOMs of Odisha.

1. Sri B. P. Mohapatra, Director(F), GRIDCO – Head of Task Force
2. Sri T. B. Mishra, COO, WESCO Utility – Member
3. Sri P. Swain, Sr. G.M.(IT), CESU – Member
4. Sri G. K. Chakrabartty, G.M.(Elect.), CESU – Member
5. Sri S. P. Mallick, Sr. G.M.(Elect.), NESCO Utility – Member
6. Sri J. C. Panda, Sr. G.M.(Elect.), SOUTHCO Utility – Member
7. Sri J.C. Mohanty, Jt. Director (IT), OERC – Observer
8. Sri S. P. Mishra, Jt. Director (Engg.), OERC – Observer

The Terms of Reference of the Task Force is as below:

1. To identify the areas for Smart Metering implementation in DISCOMs.
2. To collect and study the information on Smart Metering projects in operation elsewhere in India.
3. To finalise the requirements of key functionalities in the Smart Meters and the associated systems in the Advanced Metering Infrastructure.
4. To suggest the cost recovery plan and appropriate business model for the DISCOMs in the State.

The Task Force was required to finalise the matter and place the report for consideration of the Commission. In pursuance of the aforesaid order of the Commission, the Task Force met, deliberated, visited various sites of large-scale implementation of smart meters and prepared this report.

## Chapter 2: Relevant Provisions in India for Smart Meter Implementation

### 2.1 In Electricity Act 2003

The preamble of Electricity Act, 2003 (EA 2003) clearly states that it is "An Act for taking measures conducive to development of electricity industry, promoting competition therein, protecting the interests of consumers and promotion of efficient and environmentally benign policies". Furthermore, Sec 61 of the said Act stipulates that "Regulatory Commission shall be guided by the factors which would encourage competition, efficiency, economical use of resources, good performance and optimum investments". The implementation of SMART METERING SYSTEM, as per EA 2003, is with reference to "Promotion of efficient and environmentally benign policies".

### 2.2 Guideline of National Tariff Policy

In National Tariff Policy (NTP) 2016, the government has announced several reform measures to be undertaken in the power sector of India. It has especially increased focus on implementation of smart meter and has laid guidelines as under:

"*The Appropriate Commission may provide incentives to encourage metering and billing based on metered tariffs, particularly for consumer categories that are presently unmetered to a large extent. The metered tariffs and the incentives should be given wide publicity. Smart meters have the advantages of remote metering and billing, implementation of peak and off-peak tariff and demand side management through demand response. These would become essential in future for load-generation balancing due to increasing penetration of intermittent type of generation like wind and solar power.*

*Appropriate Commission shall, therefore, mandate smart meters for:*

*(a) Consumers with monthly consumption of 500 units and more at the earliest but not later than 31.12.2017;*

*(b) Consumers with monthly consumption above 200 units by 31.12.2019.*

*Further, Net Metering enabled smart meters shall be provided to consumers, who also sell back electricity to the grid and avail as and when they require. In order to enable energy audit in the distribution system, all distribution companies shall ensure smart meters in their electricity system throughout the chain from transformers at 132kV level right down to distribution transformer level at 11kV and further down to each*

*consumer. Further, in order to reduce theft of power, the distribution companies should have enabling feature like distribution SCADA with distribution management system and energy audit functions. SERCs shall mandate these to be in place within two years*."

**2.3 Directives of Ministry of Power**

**Hon'ble Minister of Power, Shri R K Singh** on 7th June 2018 said "*all electricity meters in the country will be smart prepaid meters in the next three years".*

While addressing a meeting with meter manufacturers, minister advised them to scale up the manufacturing of smart prepaid meters as the demand would go up in the coming years.

"*In the next 3 years, metering will go smart and gone will be the days of bills reaching your house. So need of the hour is to scale up manufacturing of smart prepaid meters and to bring down their prices.*" Singh said.

He advised the officials of the ministry to consider making such meters mandatory after a particular date. This will revolutionize the power sector by way of reduced AT&C (Aggregate Technical and Commercial) losses, better health of DISCOMs, incentivisation of energy conservation and ease of bill payments etc.

Ministry of Power vide letter No. 20/13(4) 2009-APDRP dated 26th December, 2012 constituted a Committee to review the Functional Specification s of Low Cost Single Phase Smart Meters framed by an earlier Committee. The comm ittee has been constituted under the chairmanship of Chairperson, CEA with Chie f engineer (Distribution Planning & Development) as its Member Secretary. Ot her members of the Committee were representatives from FOR(Forum of Regulators)
Secretariat, Regulatory Commissions (two nos.), Distribution utilities (seven nos.) CP RI, BIS and ISGTF (India Smart Grid Task Force).

The committee by taking the views of regulators examined the requirement of remote connect/disconnect of Smart Meter and have suggested that this feature of single phase Smart Meter can be used for following purposes:

1. Disconnection in case of tamper

2. Partial Load curtailment/Load Control
3. Disconnection on account of non-payment of bills
4. Disconnection on account of load exceeding the sanctioned limit .

All the state regulators opined favourably by raising certain clarification/ condition on remote disconnection under above mentioned circumstances.

## 2.4 Regulatory Issues to be dealt in Tariff Regulation / Orders of SERCs

The state electricity regulators framed several regulations and passed tariff orders for smooth functioning of the Utilities. However, implementation of smart meters and prepaid meters will raise issues which need to be dealt by the SERCs. Those issues are explained below:

- **Advance Payment**

  The consumer may ask interest in case of advance payment to utilities (Pre-paid smart meter). The regulator may make it clear that there shall not be any kind of interest payable to the consumer with a prepaid meter facility provided by the distribution license as in case of advanced payment by the consumers.

- **Security Deposit**

  In case of New Connection, consumer needs to pay an amount towards security deposit (SD) as per Section 47(5) of Electricity Act 2003. Existing consumers who wish to shift to prepaid the regulation may allow to adjust the Security Deposit of the consumer in the energy charge and/ or arrear of the consumer if any.

- **Incentive to Consumers**

  As per normal practice of digital payment method / advance payments etc. incentive scheme is required for prepaid consumer's with respect to the tariff for the respective categories.

- **Periodicity of meter reading/ supplementary billing**

  The regulation must clearly mention the periodicity of the activity such as meter readings, bill distribution and duty on electricity for prepaid consumers.

- **Mandatory disclosure of smart meter**

  Smart Meter and its appropriate business model need to be declared as mandatory by the regulatory bodies for acceptance by the consumers.

- **Supply and cost of meter**

An appropriate business model is required to be adopted and the sources of differential cost for implementation of smart meter to be deliberated in regulation or some flexibility to be incorporated in tariff order to encourage investors.

- **Electricity Act 2003 (Disconnection of Power Supply)**

  Section 56(1)(a)(b) of Electricity Act, 2003 says that where any consumer neglects to pay any charge for electricity due from him to license, after giving not less than fifteen days notice in written his power supply can be disconnected.

  So there is a contradiction with Section 56(1)(a)(b) of Electricity Act, 2003 in case of auto disconnection of power supply by a Prepaid meter/ Smart Meter (with prepaid facility) on the event of exhaustion of credit available in the meter.

## Chapter 3: International Scenario for Smart Meter Implementation

Technological advancements, is changing the way or rather simplifying the way electricity is measured and communicated to both producers and consumers. One such advancement gaining ground, across the world, is the use of Smart Metering technologies in the power sector.

Smart meters are becoming the meter of choice in many countries (such as Italy, Sweden, Australia, Canada and UK), they enable suppliers to provide accurate bills without manually reading the meter; help the management of supply and distribution remotely and assist customers reduce their consumption by providing accurate real time data on their consumption, which can be accessed as frequently as required (although a half hourly interval is common).

### 3.1 Smart metering deployments in the United States and Canada

In 2017, U.S. electric utilities had about 78.9 million advanced (smart) metering infrastructure (AMI) installations. About 88% of the AMI installations were residential customer installations.

AMI includes meters that measure and record electricity usage at a minimum of hourly intervals and that provide the data to both the utility and the utility customer at least once a day. AMI installations range from basic hourly interval meters to real-time meters with built-in two-way communication that is capable of recording and transmitting instantaneous data.

Number of AMI Installations by 2017

Residential- 69,474,626, Commercial-9,060,128 Industrial-365,447 Transportation-1,389

Total- 78,901,590 (***Source- US energy information Administration)***

***Link- https://www.eia.gov/tools/faqs/faq.php?id=108&t=3***

The deployment of smart meters in the United States and Canada is expected to steadily increase by **2020, representing a penetration rate of about 80 percent.** During that time frame, the United States is forecast to have about 133 million meters, while Canada is estimated to have more than 20 million smart meters.

**Major Constraint**: *The nature of the regulatory structures in the United States and Canada means that some states and provinces will delay smart meter deployment due*

*to cost/ benefit concerns. However, many of the largest population centers are covered by mandated rollouts or by approved agreements with the local regulators.*

### 3.2 Smart metering deployments in Europe

Europe will experience a significant increase in smart meter deployments to 2020, driven by government mandates and market factors. It is estimated that a total of around 200 million new smart electricity meters will be deployed across Europe, bringing the region's total smart meter population to approximately 240 million. Most European countries have adopted mandates for deployment, with a key part of the overall expected benefits being the potential to help meet their obligations under the European Union's "20-20-20" climate change targets. Germany is the only large European nation who did not mandated deployment of smart meters, but major rollouts are still expected based on the separate market assessments made by individual German Utilities. It is estimated that almost 72% of European consumers will have a smart meter for electricity by 2020.

### 3.3 Smart metering deployments in Asia and Australia

The Asia Pacific region is set to dominate the global deployment of smart metering by 2020. China is forecast to lead the way, with an installed smart meter population that could potentially approach 400 million by that date. Elsewhere in Asia, Japan is expected deploy almost 60 million smart electricity meters by 2020, largely under a market driven model. Meanwhile, South Korea is looking to position itself at the forefront of smart grid deployment globally through the government's "Green Growth" policy. As part of its broader smart grid strategy, the South Korean state utility, KEPCO, is looking to deploy between 500,000 and 1.5 million smart meters per year in homes over the next 10 years.

In Australia, only the State of Victoria has made significant deployments, due to a state-level mandate.

**Constraint**: In other Australian states, concerns about the business case and adverse media coverage have delayed significant deployments. This is set to change, however, based on the recently published "Power of Choice" paper by the Australian Energy Market Commission, the national market rule maker, Outlines the framework for a national retailer-led deployment.

## Chapter 4: Present Indian Scenario of Smart Metering System Implementation

India, with its growing economy and ever increasing demand for electricity, use of smart metering technologies can potentially offer several benefits and help solve some of the most pressing challenges of power sector. The market for smart meters is witnessing considerable growth in the last two years. This can largely be attributed to government mandates and policies, which are encouraging smart metering of power consumption for all consumers. The Central Electricity Authority of India (CEA) prepared a report on functional requirement of Smart Metering System in INDIA during August 2016. The specifications for single phase smart meters were also published by CEA. This is a stepping stone to a large scale roll out in the following years based on the learning of the pilots. Realizing the importance and need, certain government initiatives are leading the way for a move towards metering smartly in the country.

### 4.1 Pilot Projects on SMART METERING SYSTEM / SG funded by MoP

In order to kick-start demonstration projects on smart grid technologies especially based on smart metering system, the Ministry of Power (MoP), Govt. of India (GoI), allotted 14 pilot projects to different distribution companies in various states. These projects were partly funded by the MoP (50% of the project cost as a grant from GoI). These projects were meant for helping technology selection guides and business case developments for large scale projects in the next phase. Out of the 14 projects, 4 were cancelled. The rest 10 projects, which are in **various stages of execution as in December 2018**, are discussed below:-

1. **IIT Kanpur Smart City Pilot Project completed**
   - Area – Smart City Pilot in IITK Campus
   - Approved Project Cost: Rs.12.5 Cr. GoI Support: 6.25 Cr.
2. **CESC, Mysore Project declared go-live**

   The Chamundeshwari Electricity Supply Company (CESC), Mysore smart grid project involves 21,824 consumers with a good mix of residential, commercial, industrial and agricultural consumers including 512 irrigation pump sets covering over 14 feeders and 473 distribution transformers. The input energy to this area in the starting phase was 151.89 MU. The other details of the project are as follows:-
   - Functionalities – AMI, OMS (Outage Management System), PLM (Peak Load Management), MG/DG (Micro Grid / Distributed Grid)

- Consumers – 21,824
- Area – V V Mohalla, Mysore
- Consultant – POWERGRID
- SGIA – M/s Enzen
- Evaluated Project Cost: Rs.32.56 Cr. GoI Support: Rs.16.28 Cr.

**3. UHBVN, Haryana Project completed**

This pilot project in Uttar Haryana Bijli Vitran Nigam Limited (UHBVN), Haryana covers 10,188 consumers and distribution system consisting of 531 distribution transformers accounting for input energy of 131.8 MU. The other details of the project are as follows:-

- Functionalities – AMI, PLM, OMS
- Consumers – 10,188
- Area – Panipat City Sub Division
- Project implemented under grant from NEDO (Japan) by M/s Fuji Electric & Co., Japan

**4. Smart Grid Knowledge Center, Manesar Project completed**

- Project inaugurated by Hon'ble MoSP (I/C) on 19.09.2018
- Functionalities: AMI, OMS, MG/DG, EV with Charging Infra, HEMS, Cyber Security & Training Infra
- Area – POWERGRID Complex, Manesar
- SGIA – M/s Genus
- Awarded Project Cost: Rs.5.83 Cr. GoI Support: Rs.5.83 Cr.

**5. HPSEB, Himachal Pradesh Project completed and report submitted**

This pilot project in Himachal Pradesh State Electricity Board (HPSEB), Himachal Pradesh covers 1,335 industrial consumers having annual input energy of 533 MUs. The other details of the project are as follows:-

- Functionalities – AMI, OMS, PLM & PQ (Power Quality)
- Consumers – 1,335
- Area – Kala Amb Industrial Area
- Consultant – POWERGRID
- SGIA – M/s GE T&D
- Evaluated Project Cost: Rs.19.45 Cr. GoI Support: Rs.9.73 Cr.

6. **UGVCL, Gujarat**

This project in Uttar Gujrat Vij Company Limited (UGVCL), Gujarat covers 22,230 consumers in Naroda accounting for input energy of around 374.52 MU. The functionalities of Advance Metering Infrastructure, Peak Load Management, Outage Management and Power Quality Management are to be implemented for industrial, commercial and domestic consumers. The other details of the project are as follows:-

- All meters and DCUs installed and communicating to data center UAT (User Acceptance Testing) under progress
- Functionalities – AMI, OMS, PLM, PQ
- Consumers – 22,230
- Area – Naroda
- Consultant – POWERGRID
- SGIA – M/s Genus
- Approved Project Cost: Rs.23.18 Cr. GoI Support: Rs.11.59 Cr.

7. **TSECL, Tripura**

This pilot in Tripura State Electricity Corporation Limited (TSECL), Tripura covers 45,290 consumers. The functionalities of AMI & PLM are implemented for domestic and industrial consumers. The other details of the project are as follows:-

- 31,044 meters and 267 DCUs installed
- All meter received and installation in progress
- Functionalities – AMI, PLM
- Consumers – 45,290
- Area – Electrical Division No.1, Agartala
- Consultant – POWERGRID
- SGIA – M/s Wipro
- Approved Project Cost: Rs.63.43 Cr. GoI Support: Rs.31.72 Cr.

8. **APDCL, Assam**

This pilot in Assam Power Distribution Company Limited (APDCL), Assam covers 15,083 industrial and residential consumers involving 90 MU of input energy. The funding programme for the project is under RAPDRP, Part C scheme. The other details of the project are as follows:-

- 13,895 smart meters and 200 DCUs installed
- 9,319 meters communicating to Control Center
- SG system integration with RAPDRP system in progress
- Functionalities – AMI, PLM, OMS, PQ, DG
- Consumers – 15,083
- Area – Guwahati Division
- Consultant – MEDHAJ
- SGIA – M/s Fluentgrid
- Evaluated Project Cost: Rs.20.92 Cr. GoI Support: Rs.10.46 Cr.

**9. PED, Puducherry Project declared go-live on 28.12.2018**

This pilot in Electricity Department, Govt. of Puducherry (PED) covers 34,000 no. of consumers, the dominant being the domestic consumers (79%). The other details of the project are as follows:-

- 25,535 smart meters and 253 DCUs installed
- CC (Control Centre) hardware and software installed
- Functionalities – AMI
- Consumers – 34,000
- Area – Division 1 of Puducherry
- Consultant – POWERGRID
- SGIA – M/s DFE, China
- Evaluated Project Cost: Rs.35.53 Cr. GoI Support: Rs.17.76 Cr.

**10. WBSEDCL, West Bengal**

This pilot in West Bengal State Electricity Distribution Company Limited (WBSEDCL), West Bengal covers 4 nos. of 11 KV feeders with 5,265 consumers. This area consisting of residential and industrial consumers has a consumption of 42 MU input energy. The other details of the project are as follows:-

- All meters and DCUs installed.
- 3600 meters communicating
- SG (Smart Grid) system integration with RAPDRP system completed. Testing under progress
- Functionalities – AMI, PLM
- Consumers – 5,265
- Area – Siliguri Town

- Consultant – POWERGRID
- SGIA – M/s Chemtrols
- Approved Project Cost: Rs.7.03 Cr. GoI Support: Rs.3.52 Cr..

**4.2 AMI / SG Projects under National Smart Grid Mission (NSGM)**

During the implementation of Smart Grid Pilot projects in State Utilities, it was felt that smart grid efforts required urgent concerted focus for which it was necessary to create a comprehensive institutional arrangement capable of dedicating manpower, resources and organizational attention needed to take it forward. That gave birth to National Smart Grid Mission (NSGM) under Ministry of Power, Govt. of India with prime objective to accelerate Smart Grid deployment in India. NSGM has been operational since January 2016 with a dedicated team to plan and monitor implementation of the policies and programmes related to Smart Grid in the country. The projects funded (30%) by NSGM, which are in **various stages of execution as in December 2018**, are discussed below:-

1. **CED, Chandigarh (Sub Div-5)**

   The Chandigarh Electricity Department (CED), Chandigarh (Sub Division 5) smart grid project involves 29,433 consumers. REC Power Distribution Company Ltd. was appointed as Project Management Agency on 30.08.2016. CED formed a Smart Grid Cell and SLPMU for carrying the project forward.

   - AMI awarded to M/s Analogics Tech and SCADA awarded to M/s Synergy Systems
   - Functionalities – AMI, DTMU (Distribution Transformer Monitoring Unit), SCADA
   - Consumers – 29,433
   - Area – Sub Division 5 of Chandigarh
   - PMA – RECPDCL (REC Power Distribution Company Limited)
   - Approved Project Cost: Rs.28.58 Cr. GoI Support: Rs.8.6 Cr.

2. **CED, Chandigarh (Complete City Excluding Sub Div-5)**

   - Sanction letter issued to CED on 28.09.2018. Acceptance received
   - Functionalities – AMI, SCADA, DTMU
   - Consumers – 1.84 lakh
   - Area – Complete Chandigarh City (excl. SD5)
   - Approved Project Cost: Rs. 241.49 Cr. GoI Support: Rs.72.45 Cr.

3. **KSEB, Kerala**

This smart grid project of Kerala State Electricity Board (KSEB)**,** Kerala involves 0.9 lakh consumers in Kochi city.

- Sanction letter issued to KSEB on 28.09.2018
- Functionalities – AMI, PLM, DTMU, EVCI (Electricity Vehicle Charging Infrastructure), PV (Solar Photo Voltaic)
- Consumers – 0.9 lakh
- Area – Kochi City
- Approved Project Cost: Rs.90.07 Cr. GoI Support: Rs.27.26 Cr.

4. **JBVNL, Jharkhand**

This smart grid project of Jharkhand Bijli Vitran Nigam Limited (JBVNL)**,** Jharkhand involves 3.6 lakh consumers in Ranchi city.

- NIT (Notice Inviting Tender) issued on 22.12.2018
- Functionalities – AMI, DTMU
- Consumers – 3.6 lakh
- Area – Ranchi City
- Approved Project Cost: Rs.228.69 Cr. GoI Support: Rs.68.61 Cr.

5. **OPTCL, Odisha**

This smart grid project of Odisha Power Transmission Company Limited (OPTCL)**,** Odisha involves 0.87 lakh consumers in Rourkela city.

- Sanction letter issued to OPTCL on 28.09.2018. Acceptance received
- Functionalities – AMI, SCADA, DTMU
- Consumers – 0.87 lakh
- Area – Rourkela City
- Approved Project Cost: Rs.96.97 Cr. GoI Support: Rs.29.09 Cr

**4.3 Other Projects with Large Scale SMART METERING SYSTEM Implementation**

1. **Kota, Rajasthan**

CESC (Calcutta Electricity Supply Company) has been entrusted with the responsibility of power distribution in this Kota city area which is spread over 150 sq. km with 2.08 lakh consumers having annual input energy of 1200 MUs in FY 2017-18. Kota Electricity Distribution Limited (KEDL), a fully owned subsidiary of CESC Ltd., commenced its operation at Kota on 1st September 2016

as a distribution franchisee under Jaipur Vidyut Vitaran Niganm Ltd. (JVVNL) for a period of 20 years.

(i) Project Details: September 2016 (Took over as Franchisee)
June 2017 (Smart Meter Implementation Started)
Initially, 200 meters were installed per day & now, 800 meters installed per day with 80 teams in the field.
**65,000 smart meters installed by Oct. 2018.**

(ii) Project Period: 20 Years

(iii) Total Cost of the Project: **Rs.137 Crore**

(iv) Business Model: Capex model with 20 years period for recovery. The revenue earned by achieving a reduction in AT&C loss over the base line data will be equally shared by the Franchisee and the DISCOM throughout the agreement period.

| Single Phase | Three Phase | LTCT | Total | Technology |
|---|---|---|---|---|
| 1,80,000 | 26,000 | 2,000 | 2,08,000 | 1. RF Mesh Communication to Gateway with redundancy to follow alternate path in case of failure of any Gateway.<br>2. Gateway to Server (Cloud) Communication over GPRS 4G. |

(v) AMI Related:

**Capabilities:**

(i) The communication device of the smart meter (NIC) is pluggable ensuring that the meter can be adapted to other communication technologies almost seamlessly.

(ii) One Access Point (AP) costing around Rs.4 lakh can aggregate 12,000 smart meters. However, CESC, in this project has kept some redundancy and is allowing an AP to handle 5000 meters. As such, they have deployed 45 APs for 2.08 lakh smart meters.

(iii) HES and MDMS are on the cloud and hence, the services can be procured with a charge per month. The MDMS has business intelligence (BI) tools like Operations Optimizer which can provide answers to several regular as well as adhoc queries on the meter / consumption data. There are also Apps using which consumer can see the consumption pattern on the mobile.

**Provided By:**

(i) Meter - M/s Genus Power Infrastructures Ltd.
(ii) Head End System – (HES) M/s ITRON
(iii) Meter Data Management System - (MDMS) M/s ITRON
(iv) System Integrator - CESC Ltd. / KEDL

**2. Indore, Madhya Pradesh**

The area for AMI Project consists of 15 Zones of Indore City Circle of MPPKVVCL (Madhya Pradesh Paschim Kshetra Vidyut Vitaran Company Ltd.) with 75,430 consumers. L&T, the System Implementer commenced its operation from June 2018.

(i) Project Details: June 2018 (Smart Meter Implementation Started)
**3,000 smart meters installed by Oct. 2018.**
(ii) Maintenance Period: 5 Years
(iii) Total Cost of the Project: **Rs.75 Crore**
(iv) Business Model: Capex model with funding under IPDS & State Govt.
(v) AMI Related:

| Single Phase | Three Phase | LTCT | Total | Technology |
|---|---|---|---|---|
| 67,000 | 7,150 | 1,280 | 75,430 | 1) RF Mesh Communication to Gateway with redundancy to follow alternate path in case of failure of any Gateway.<br>2) Gateway to Server (Cloud) Communication over GPRS 4G. |

**By:**

(i) Meter - M/s L&T Ltd.
(ii) Head End System – (HES) M/s CyanConnode (Cloud based)
(iii) Meter Data Management System - (MDMS) M/s L&T Ltd.
(iv) System Integrator - M/s L&T Ltd.

**3. UP (47 Towns)**

The area for SMART METERING SYSTEM Project consists of 47 Towns of Uttar Pradesh across 5 DISCOMs (PuVVNL, PVVNL, MVVNL, DVVNL and KESCO) with 40 lakh consumers. The EESL (Energy Efficiency Service Limited)

will make the upfront capital investment and will recover its investment in long term out of gains of the project on OPEX basis.

(i) Project Details: The Meter Supplier & System Integrator have been selected through International Competitive Bidding P:rocess. In 1st year (Phase-I), 14.88 lakh smart meters will be installed. In 2nd and 3rd years, the smart meters to be installed are 14.39 lakh and 10.73 lakh respectively.

(ii) Project Period: 8 Years

(iii) Total Cost of the Project: **Rs.2250 Crore**

(iv) Business Model: In the OPEX based Cost methodology, the EESL is to incur CAPEX during built-up phase and OPEX during built-up and O&M phase. In this process, the DISCOM will pay to EESL on per Meter per Month basis, on number of Meters communicating Billing Data with Billing System, after the project goes live. **The per Meter per Month cost is calculated as total Project Cost spread over the actual recovery period and it comes out to Rs.86/-.**

EESL will transfer the assets at zero cost after completion of life of meter as prescribed in rollout plan. Thereafter, DISCOMs will bear the replacement cost of the defective meters on actual basis & O&M cost of the AMI system.

(v) AMI Related:

Technology - The smart meter has a pluggable communication hardware which supports data communication band of 2G & 3G. Either EESL shall provide services on continuous basis with the same technology or if technology does not support during project duration, it shall be upgraded by EESL.

**Provided By:**

(i) System Integrator - M/s L&T
(ii) Meter - Genus, ITI, Zen & Keonics
(iii) Billing System
Implementing Agency- M/s HCL (R-APDRP) &
M/s Fluentgrid (Non RAPDRP)

# Chapter 5: Smart Meter with its key functionalities and Smart Metering System

## 5.1 Introduction

Electricity meters have shown gradual progress over the years. It started with electromechanical meters and then graduated to static meters with higher accuracy and reliability in measurement. The business needs of the utility then paved the way for introduction of new functionalities in the electricity meters. In 1970s, South Africa introduced prepaid metering system in the localities where it was difficult to collect the dues from the consumers. In the late 1980s, USA introduced AMRs (Automatic Meter Readers) to read meters installed in inaccessible areas. In AMR, there exists one way communication from meter to the utility's computer for reading the data recorded in the meter. In early 21st century, the utilities felt the need to have two way communications between the meter and its computer/server for remote connection/disconnection of the meters in addition to meter reading. This gave birth to a new type of electricity meter with two way communication called as Smart Meter.

In IS 16444, BIS defines Smart Meter as "Smart Meters are a composite unit with static energy meter, communication module and control element. The smart meter also will have Time of Day registers. A smart meter will have functions like measurement, computation, event capturing, storing, communication and control. The smart meter would be required to provide data and information that are needed by various smart grid applications."

## 5.2 Key Functionalities of Smart Meter

The smart meter shall help utility to manage their resource and business process efficiently. Smart meter shall support the following minimum functionalities: in compliance with IS 16444 Part 1 & 2 standard and IS 15959 standard

**Advanced Metering Infrastructure/Smart Metering System:**

The function of the smart meter can only be achieved by clubbing network and hardware components. The whole system objective is to enable two way communications between smart meter and the utility servers to execute the remote reading, monitoring & control of electrical energy meters to serve as repository of records for all raw, validated and edited data. The whole system can be named as Smart Metering System (SMS)/ Advanced Metering Infrastructure (AMI).

In this connection, CEA has formulated the functional requirements of Smart Metering System (SMS) after consultation with various stake holders. These functional requirements include the technical specifications of single phase and three phase whole current smart meters which are framed on the basis of BIS standards i.e. IS 16444 & IS 15959 for smart meters and communication protocols respectively.

The basic components of SMS can be summarized as

5.2.1 Smart meters

5.2.2 Communication infrastructure

5.2.3 Head End System (HES)

5.2.4 Meter Data Management System (MDMS)

5.2.5 Web Application & Mobile App with updated on line data of consumer

**5.2.1 Smart Meters**

Smart meters should have the following capabilities and render the associated advantages to the utility:-

**(i) Measurement of electrical energy parameters accurately and precisely**

The electrical energy parameters are measured accurately and stored in the meter for every pre-defined interval of time. This, when analysed can provide the consumption pattern of the consumer, power quality etc.

**(ii) Two way communication with the Utility Server**

It refers to communication between meter and Utility server. In two way communication, meter not only sends metering information to the utility servers but also Utility server send command to the meter to perform certain operations. Two way communication features bring the following benefits,

**a. Remote configuration**

Smart Meter can be remotely configurable so that configurations in the meter like power outage issues, tariff change, user request to increase load limit etc. can be updated.

**b. Remote connect & disconnect**

Through its networking capabilities, the smart meter can be operated remotely from the Utility servers. If a consumer is not paying electricity bills and his dues cross a certain threshold, Utility can disconnect the power supply remotely. And, after bills are paid, the meter should be connected

again remotely and power supply is resumed. This feature enable a single Smart meter to function either as a post paid or Prepaid meter.

**c. Remote firmware upgrade**

Firmware software can be upgraded/ replaced remotely for all consumers so that the manual up-gradation cost and time taking process can be avoided. *This feature should be carefully selected as it can also open up the chance of tampering of meter Firmware.*

**d. User friendly display**

Smart meter has a user-friendly Consumer Interface Unit (CIU)/ android app using which a user can request for services like billing details, lodging complaints regarding electricity issues, for viewing load pattern and notifications from Utility etc.

**e. Time of day (TOD)/ Time of usage(TOU) metering**

The tariff is higher during peak periods and is lower during off peak periods. The TOD / TOU tariff is decided by the Regulators along with the ARR (Annual Revenue Return) and is known to the consumer. With AMI installation, it will be very easy to implement TOD /TOU tariff and incentivize the consumers to shift their non-essential load from peak to off peak periods.

**f. Pre-paid functionality**

Pre-paid metering operates on the concept of 'pay before you use. It offers a rewarding alternative to the conventional post-paid metering system which would inherently address the issue of low collection efficiency by eliminating the need for collection itself.

**g. Net Metering/Billing**

Smart meter can perform meter reading automatically for energy accounting and auditing, billing and collection. Net metering is the billing mechanism that credits solar energy system owners for the electricity they add to the grid after their own consumption. For example, if a residential customer has a solar PV system on the home's rooftop, it may generate more electricity than it consumes at home during daylight hours.

**I. Alarm/Event detection, notification and reporting**

There are indications to get attention for alarms and warning raised for over load, power theft etc. with intimation of the same to the Utility server/ AMI system on real time basis.

**(iii)Demand Management**

**a. Demand Profiling**

The load profiling feature on the smart meter keeps the record of how much load a consumer uses throughout the day/ month/ year. This data will help in estimating power demand properly.

**b. Demand Response**

Smart meter can perform demand response in the following ways:-

- Comparing real time load and raising alarm to utility if the user crosses the defined threshold limit.
- Informing consumer about the increase of loading excess of predefined condition.
- Disconnecting the load within stipulated time in case of exceeding load/maximum demand.
- Using bidirectional communication for notifying the utility regarding actual load at the time of partial or full load disconnection.

**(iv)Outage Management**

Smart meters can transmit to utilities real-time outage alerts. Sometime this notifies utilities about outages sooner than customers can call in — a considerable benefit to both utilities and customers.

**(v) Security**

It is to prevent unauthorized access to the AMI/SMS including Smart meter & meter data etc. and to ensure authentication of all SMS elements by third party.

**(vi)Integration**

with other existing systems like Billing & collection software, GIS mapping, consumer indexing, new connections & disconnection, analysis software, Outage Management System etc.

These are only an indicative but not an exhaustive list. The meter should be capable to support the other functionalities as per the requirement of utilities.

### 5.2.2 Communication Technology and Infrastructure:

#### 5.2.2.1 Communication Infrastructure:

This refers to the data network based on varied communication technology. The evolution from AMR to AMI/SMS and then to Smart Grid deployment necessitates the need to ensure that these networks are future proof. Since the network is the foundation block for advanced metering services it has to be robust, with emphasis on the speed with reliability and security in the network. 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.

To build a cost effective and efficient metering communication the options are.

A. Go for separate networking solution only meant for smart metering communication.
B. An add-on metering communication feature on existing well established network solution like GSM/ GPRS.
C. A hybrid solution which is a mix-up of two solutions. i.e. a separate one and an add-on metering communication feature on existing network.

Some of the key criteria that need to be taken care of while selecting communication network are:

- Bandwidth
- Load and responsiveness
- Coverage area
- Redundancy
- Time synchronization
- Meter profile changes
- Missing Data

#### 5.2.2.2 Communication Technology:

There are basically two stages of communication in the system, namely, that between the MIUs (Meter Interface Unit) of the smart meters and the RF Nodes / DCU ( Data Concentrator Unit), and that between the DCUs and the HES. The channel used between DCU and HES is mainly GPRS mode.

The general communication technologies adopted between MIU to DCU:

A. PLCC (Power Line Carrier Communication)
B. RF (Radio Frequency) Mesh

C. GPRS (General Packet Radio Service)

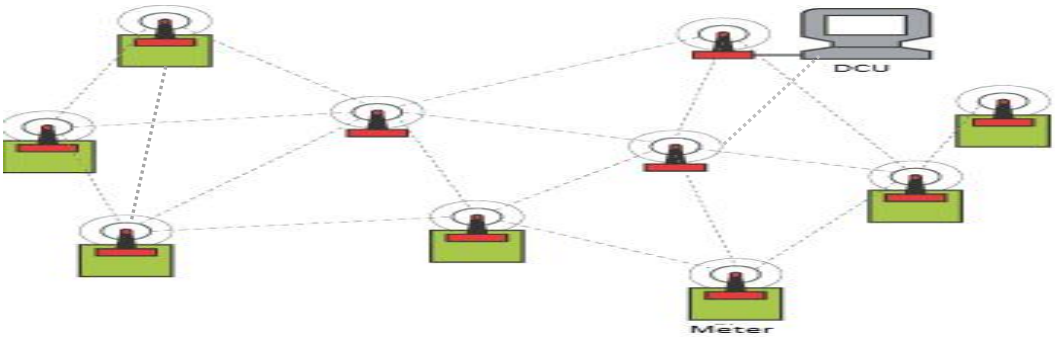
**A. PLCC (Power Line Carrier Communication)**

This type of communication technology is used for transfer of data in the sub MIUs and DCU. This system is set up with a DCU at the secondary side of a Distribution Transformer. The DCU can be viewed as the front end of the sub-system, collecting meter readings from all the MIUs connected to it through the low voltage power line carrier (PLC) and communicating with the HES through the communication channel.

**B. Radio Frequency (RF) or Wireless Mesh Network Communication:**

A **wireless mesh network** (**WMN**) is a communication network made up of radio nodes organized in a mesh topology. Wireless mesh networks often consist of mesh clients, mesh routers and gateways. The mesh clients are meters, DCU/ Node while the mesh routers forward traffic to and from the gateways. The coverage area of the radio nodes working as a single network is sometimes called a mesh cloud. Access to this mesh cloud is dependent on the radio nodes working in harmony with each other to create a radio network. A mesh network is reliable and offers redundancy. When one node can no longer operate, the rest of the nodes can still communicate with each other, directly or through one or more intermediate nodes. The animation below illustrates how wireless mesh networks can self form and self heal. Wireless mesh networks can be implemented with various wireless technology including 802.11, 802.15, 802.16, cellular technologies or combinations of more than one type.

**Block Diagram:**




**License free RF Bands in India for Low Power RF Applications**

**Advantage of RF over PLC:**

| Sl.NO | PLC Technology | RF Technology |
|---|---|---|
| 1 | It get noisier as people add more and more devices in their homes | Less noisier |
| 2 | Reliability of PLC network reduces after 2-3 years | Reliable |
| 3 | PLC technologies are tougher to work. So the error is increased during development and deployment. | RF technologies are easier to work. So the error can be reduced during development and deployment. |
| 4 | PLC is suitable where delay between subsequent data transformer is higher | RF is suitable for high regularity |
| 5 | PLC is more suitable for home network | RF is more suitable for outdoors. |
| 6 | Limitations of working under high temperature, vibration conditions. | No effect of temperature |
| 7 | Its communication strength depends on line distance and surrounding high noise | No effect as the communication established by taking each meter as a node of communication. |

**C. GPRS Communication:**

This type of communication technology is known as second stage communication technology. The communication technology/channel used between DCU/ node and HES is GPRS. GPRS based AMI System is a comprehensive management platform for utilities. This system enables the collection and management of all energy data, measuring and monitoring consumption, collecting and remotely analyzing usage data and ensuring a fully integrated operation.

**Comparison between GPRS, RF and PLC Mode of Communication:**

| Sl. No | GPRS Mode of communication | RF Mode of communication |
|---|---|---|
| 1 | GPRS is essentially one to one communication. The maximum speed available is up to 10MB/Sec as per the network preferred. | Dedicated speeds of 100-250 kbps |
| 2 | It shall be difficult to support the dynamic pricing in this case owing to the sequential delay of operation | Built in broadcast and multicast commands for near simultaneous shutdown , load control and tariff management |
| 3 | GPRS is mainly designed for data downloading (browser style information), where as meter | Upload and download speed is same |

| | | |
|---|---|---|
| | data is mainly data uploading (meter to server). GPRS bandwidth reduces to 1/4th on upload | |
| 4 | For provisioning dynamic IPs for so many meters linked to their SIM numbers, huge investment will be required for servers. | Since the requirement of dynamic IPs will be reduced , low cost low power servers can manage. |
| 5 | GPRS is highly unreliable in rural areas.. | The advantages of RF reliability and low cost become more prominent in rural areas – India being essentially a rural economy. It offers no disadvantage in urban areas. |
| 6 | GPRS connections are highly susceptible to Digital Drop Out or call drop. Reconnection time is nearly 20 sec. | 100% uptime |
| 7 | Real time connection and time synchronization is impossible due to built in packet latencies. | Packet latencies are fixed and hence time can be synchronised accurately |
| 8 | The present revenue model of GPRS for telecom companies may not justify 10s of millions of SIM cards logged to the servers at all time. There may be a huge increase in running costs. | 99.9% of the network is independent of telecom operators |
| 9 | Since the GPRS card is always in communicating mode, the power consumption is huge. It is more than 10 times of RF mode. | Negligible power requirement |
| 10 | To address the issue of tampering, the modem needs to be sealed inside the meter. If GPRS technology gets outdated (the case is most likely as it is very inefficient use of available bandwidth), all such meters will again have to be replaced. | The modem exists only on DCU, and can be easily replaced with upgraded Technology |
| 11 | There is not even a single notable installation of GPRS AMR across the full spectrum of industrial / commercial / household and agricultural connections. It is still restricted to small quantities for industrial and large commercial establishments. | 100s of thousands of RF meters getting installed in electric meters, gas meters and water meters worldwide every month. |
| 12 | GPRS works in a scarce radio resource where voice takes precedence over data priority. With voice growing rapidly, the fate of reliable data in bandwidth hungry in mobile continues to remain uncertain unless data itself upgrades to 3G and 4G. | No limitation |

| | | |
|---|---|---|
| 13 | Fixed cost is very high. | Fixed cost less compared to GPRS mode of communication. |
| 14 | Running cost is very high. | Negligible in comparison – in fact the total investment cost in RF technology can be recovered in few months.<br>Operating cost of GPRS. |
| 15 | For Home Area Network – extra cost in RF module inside each meter. | Already provided |
| 16 | The SIM card change on site is a huge cost if service provider is changed retaining the same number. | No such constraint |

### 5.2.3 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. It pulls the meter data to the computer and also sends out utility's commands to the meter. HES shall support storage of raw meter data, alarms and alerts as per the design.

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

- Acquisition of meter data on demand & at user selectable periodicity
- Two way communication with meter/ DCU.
- Signals for connect & disconnect of switches present in end points like meter
- Event logging & Alarm triggering
- Encryption of data for secure communication
- Maintain time sync with DCU / meter
- Store raw data for a defined duration
- Handling of Control signals / event messages on priority
- Setting of Smart meter configurable parameters
- Successful communication device status and history of communication success rate between smart meter & HES.
- Network information in case more than one technology is deployed in field between the two devices
- Critical and non-critical reporting functionality.
- HES shall facilitate programming to support the meter and the SMART METERING SYSTEM functionalities.

### 5.2.4 Meter Data Management System (MDMS)

The Meter Data Management System supports storage, archiving, retrieval & analysis of meter data and various other MIS reports along with validation & verification algorithms. It shall act as a central data repository. MDMS 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, consumer Information system, customer care, analytics, reporting, Network planning & analysis, load analysis/forecasting, peak load management, outage management etc.

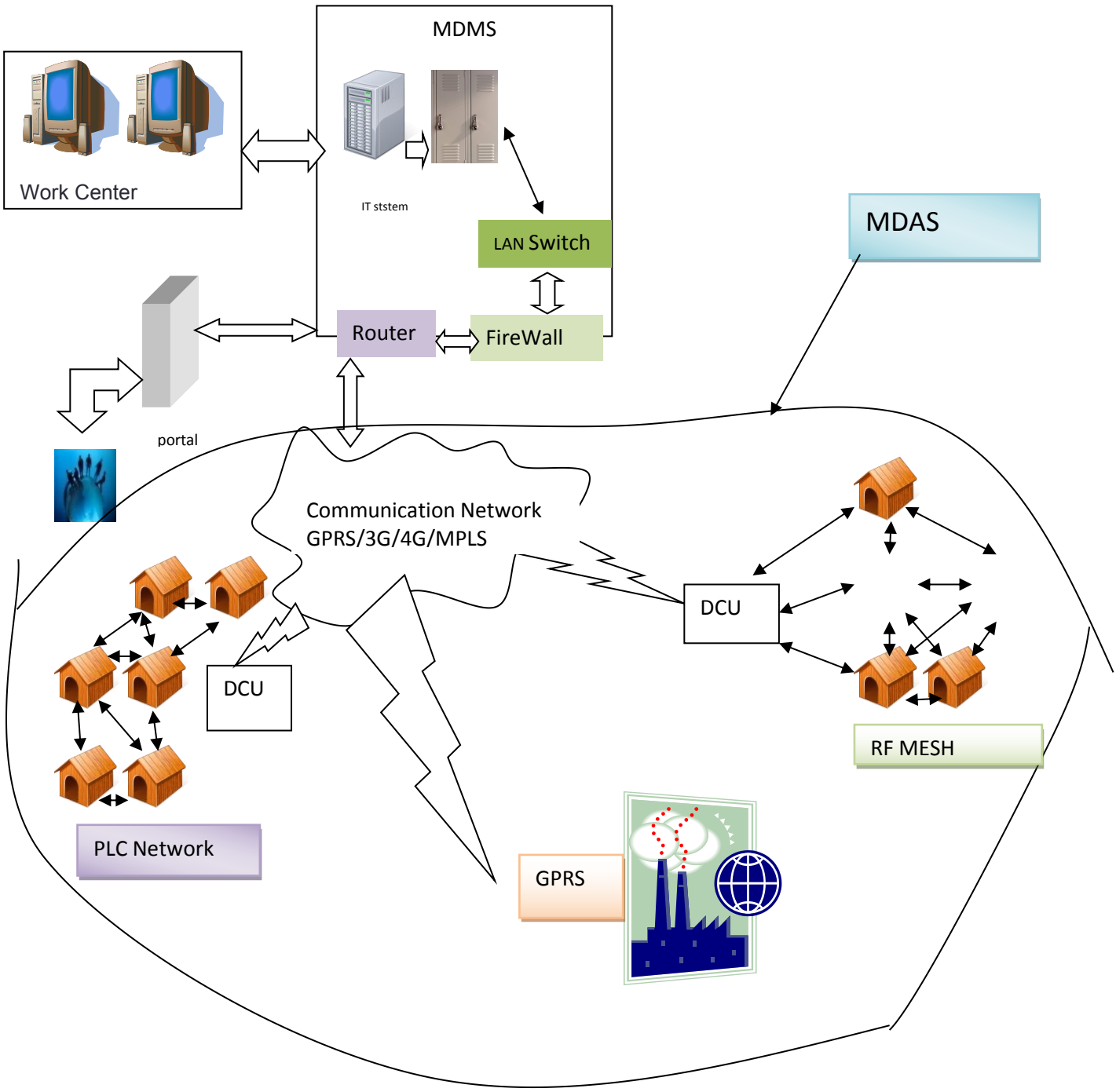
MDMS should also support the future requirement of utility and should support the integration of other smart grid functionalities like Distribution Transformer Health Monitoring system, self-healing system etc. as and when implemented by the utility.

The MDMS shall have the ability to selectively choose which data to be maintained and which to be purged or archived as per the requirement of Utility

The functions of MDMS can be are:

A. AMI installation support
B. Meter Data validation, estimation and editing.
C. Billing determinants calculations
D. Exception management
E. Service orders
F. Customer Service support
G. Analysis
H. Reporting
I. Revenue protection support
J. Asset management
K. Demand control / Demand response support
L. Other functionality support of AMI.
M. Net Metering / Prepaid Metering
N. Performance level monitor.

**Communication Architecture Diagram:**




### 5.2.5 Web application with updated online data consumer

The MDMS provides web and mobile application to the consumer for understanding the consumption pattern, load drawn profile along with account details in case pre paid meter.

## Chapter 6: Cost Benefit Analysis of SMART METERING SYSTEM Implementation in a DISCOM

The teams, consisting of members from the Task Force, visited SMART METERING SYSTEM installations across the country, studied the cost involved and the recovery plan in those projects. From that study, the timeframe and the cost benefit analysis for implementing RF mesh/ Canopy based smart metering solution for a compact urban area (a Division or 3-4 Sub-Divisions) having 1 lakh consumers was calculated as given below:-

**Cost Benefit Analysis:**

The Capex for deploying SMART METERING SYSTEM for 1 lakh consumers is Rs.5158 lakh (Annexure-I) and the Avg. O&M cost of the system per annum is Rs.287 lakh (Annexure-II).

**Benefits to distribution companies**: The benefits to DISCOMs on deployment of SMART METERING SYSTEM for 1 lakh customers are calculated at Annexure-III. It can be seen that an annual benefit of Rs.1324 lakh accrues to the DISCOM for such deployment of SMART METERING SYSTEM.

**Payback period calculation:**

In the business model at para 7.3 two alternatives of payback period calculation have been made:

**i.** 100% Capex by the SI.

**ii.** 70% Capex by the SI + 30% Capex by the way of Capital Grant,

Considering financial charge @ 10% on the annual reducing balance of Capex over the maintenance period of 8 years and PMC @ 2.5% of Capex, the payback period works out to 5.18 years and 5.10 years respectively under alternative (i) & (ii). The effective rate per bill works out to Rs84 and Rs60 respectively.

# Chapter 7: Recommendation of the Task Force

In pursuance to the decision of the OERC, the task force after studying the latest developments on smart metering projects in operation elsewhere in India and analysing the ground realities in the DISCOMs of Odisha recommends the way forward for implementing smart metering in the following paragraphs.

## 7.1 Criteria for Identification of area in DISCOM for SMART METERING SYSTEM implementation

In rural areas because of remoteness of the place, it is difficult to enforce discipline among the consumers, resulting in high AT&C loss. Besides they suffer from low RPU coupled with weak communication network. However, the communication network which is the backbone of any smart metering system is more reliable in compact Urban/Semi Urban areas. Further a high RPU combined with moderate AT&C loss in a compact Urban/Semi Urban area is preferable as it is likely to be more effective and administratively convenient to enforce, yielding a positive result within a short span of time. This can set as a model for introduction of smart metering in other areas. Therefore it is proposed to implement this in Urban and Semi Urban areas and be prioritised in the following order.

**(i)** High RPU with Moderate AT&C loss.

**(ii)** Moderate RPU with Moderate AT&C loss.

**(iii)** Low RPU with High AT&C loss.

Hence, the Task Force recommends the selection of few divisions/sub-divisions in a predominantly Urban/Semi Urban area. The list of such areas satisfying the above level of priority is attached herewith as Annexure-V.

## 7.2 Study of Smart Metering Projects elsewhere in INDIA

The task force visited 4 different places where Smart Metering Projects have been recently implemented and are in successful operation. The statement of field visit report in tabular form on such smart metering projects is at Annexure- VI. The number of consumers catered ranged from 34 thousand to 5 Lakh. The inputs from this study have been suitably used to prepare this report.

## 7.3 Business Model

The Smart metering infrastructure is a very complex system and quite new having varied components like Smart meter, Communication System, HES, MDAS etc.. Each component has its own intricacies. There are multiple suppliers and multiple service providers for the entire system. In order to have a smooth functioning of the system we need one System Integrator (SI) unlike an EPC contractor, who will not only look after installation of the system, but also takes care of operation & maintenance of the same for at least 8 years to derive potential benefit from the system.

The DISCOMS are not financially sound to implement Smart metering project on their own which involves high amount of Capex. Therefore, the System Integrator has to bring in requisite finance also to support the Capex. Thus the business model has to be on Build, Own, Operate and Transfer (BOOT) basis wherein the System Integrator takes the responsibility of the project during Implementation, Operation & maintenance period and transfer the same after expiry of definite period of the project. The SI shall get back its investment by way of collection of monthly rentals over the period.

Presently a sum of Rs. 40 is being recovered per month from the consumers towards Meter Rent. It is suggested that existing rate of recovery towards meter rent from the consumer may continue in future during the pendency of the above project so that, there will not be any resistance from the consumers on account of meter rent. The additional amount may be borne by the DISCOMs which will be compensated by the savings made through reduction in AT&C loss.

There is a possibility that Govt. will show interest in Smart Metering Project in the Utilities following the completion of the "Power for All" programme. Govt of India is expected to provide some Capital grant for implementation of Smart Metering project with certain additional grant from State Govt.. Under National Smart Grid Mission (NSGM) Scheme Central Govt. is providing 30% grant for implementation of Smart Grid in selected cities, Rourkela being one of the beneficiaries. An attempt may be made to obtain as much capital grant as possible for the project. The capital grant will be factored and the monthly rental will be reduced accordingly.

The Tender for the System Integrator will be so designed that the successful bidder will be selected based on lowest rate quoted for monthly bill. While quoting the rates the bidder shall consider Capex, Opex, Financing Cost and Overheads, after factoring capital grant available from the Govt., if any. This mode of payment to the System Integrator will be simple and with single monthly charge per effective billing. This will help bringing down the AT & C Loss and improvement in financial condition of the DISCOMs.

An illustrative calculation of recovery per effective bill considering two alternatives: (i.) 100% CAPEX by SI (ii.) 70% CAPEX by SI+ 30% grant, is given below.

| Sl no | particulars | 100% CAPEX by the SI | 70% CAPEX by the SI + 30 % grant |
|---|---|---|---|
| 1 | No of Consumer | 1 Lakh | 1 Lakh |
| 2 | Total estimated CAPEX | Rs.5158 lakh | Rs.3611 lakh |
| 3 | Total OPEX | Rs.287 lakh | Rs.287 lakh |
| 4 | Finance charge @ 10% over Capex | Rs.2484lakh | Rs.1739 lakh |
| 5 | PMC fees @ 2.5% of Capex | Rs.129 lakh | Rs.129 lakh |
| 6 | Total | Rs.8058 Lakh | Rs.5766 Lakh |
| 7 | Effective rate per bill Over 8 years of billing | $\frac{8058}{(8X12X1,00,000)}$ =84 Rupees | $\frac{5766}{(8X12X1,00,000)}$ =60 Rupees |
| 8 | Payback period | $\frac{5158}{84X12month}$ = 5.12 Yeras | $\frac{5158}{60X12month}$ = 5.0 Yeras |

The estimated savings on reduction of AT&C loss and on improvement in operations of the DISCOMs works out to about Rs. 13 crore as given in Annexure-III which will further bring down the payback period.

## 7.4 Communication Technology

Communication technology for meter to HES is the prime function of Smart Metering Infrastructure. The available communication technology is RF Mesh / Canopy or GPRS. The technologies to be adopted shall be as per suitability. These communication technologies have their own merits and demerits. RF mesh/ Canopy require high amount of CAPEX. On the other hand GPRS require high recurring cost having no significant CAPEX.

Hence the task force proposes to remain technology neutral and to leave the choice of communication technology upon the SI with a condition for complying with all the performance parameters for functional requirement as per Service Level Agreement (SLA). The performance parameter is enclosed herewith as **Annexure- IV.**

## 7.5 Roadmap

### 7.5.1 Formation of a Dedicated Cell for smart metering Implementation

COO / AO of the DISCOM shall drive this initiative of implementing Smart Metering Project implementation. A dedicated Cell for Smart Metering (CSM)) headed by an officer in the rank of G.M. or above, may be created in each DISCOM for implementing the Smart Metering Project in line with the business model mentioned above. The cell will have personnel from Technical, commercial, MRT and IT wings of the DISCOM and will be responsible for all the stages of the project: (a) Planning, (b) Environment Management (c) Selection of Project Management Consultant, (d) Selection of System Integrator, (e) Project implementation for 2 years and maintenance of the project for 8Years.

The CSM (Cell for Smart Metering) will adopt the business model mentioned above and will coordinate with System Integrator and the PMC for the project and will report periodically to COO/AO of the DISCOM.

### 7.5.2 Selection of Project Management Consultant (PMC)

Before implementation of the project, the requirement of a competent Project Management Consultant (PMC) is utmost important particularly in such kind of projects. The PMC for the project shall be selected through two part single envelope bidding system. The selection of successful PMC shall be done through QCBS methodology based on their domain knowledge and experience in handling similar

projects. The PMC in association with CSM shall survey the Division/ Sub Divisions where Smart Metering project is decided to be implemented. The PMC will prepare the design, drawing, technical specification and prepare the DPR and bidding document for floating the tender for participation by prospective System Integrator. They will also assist DISCOM in selection of the SI and will be involved during implementation of the project.

### 7.5.3 Environment Management:

This being a new concept, with which neither the employees nor the consumers are familiar, may face resistances in its introduction and needs an effective change management. Keeping this in view, several meetings with different stake holders of the society may be conducted to implant the idea of smart metering and how it is beneficial to the consumers. Parallel activities like seminars, conferences and workshops inviting media representatives may be conducted to spread the positive aspects of such metering. It would be prudent to install the smart meters along with the existing general meters on sample basis in certain locations to create awareness and instil confidence amongst consumers. They may be informed about the additional advantages of smart meters over the existing meters to take them on board before popularising the Smart Meters. A mobile testing van may be engaged for six months from the date of final installation of meter in an area for testing of Smart Meters at consumers place for instilling confidence in the consumers.

### 7.5.4 Implementation period-

**Capex**

To start with, the implementation period covering Selection of PMC, selection of SI and actual implementation is expected to be 24 month ( 2 Years)

**Timeframe:**

| Sl. No. | Activity | Time Required in Months |
|---|---|---|
| 1 | Selection of System Implementer / System Integrator | 3 |
| 2 | Planning and Procurement Phase | 3 |
| 3 | Environment Management Phase | 4 |
| 4 | Implementation Phase (450 Meters per day in an average) | 8 |

**TOTAL = 18**

**For Opex -** Operation and Maintenance = 96month (8 Years)

### 7.5.5 Implementation:

The installation of Smart Meters and implementation of Smart Metering System shall be done by System Integrator. The installation will include dismantling of old meter, installation of new smart meter, submission of data/ information/ meter reading/ photographs of old & new meters. During their visits to places with large scale Smart Metering System installation, the Task Force learnt that the major problem faced in implementing such projects was the acceptance of the new system by the consumers. Therefore, message should spread that the Smart Meter is similar to existing meter with certain additional functionalities, beneficial to the consumers in long run. **No extra meter rent should be levied on the consumer on this account.** However the system should be implemented phase wise to gain acceptability among the consumers and employees. In the first phase, it should be implemented in Urban/Semi Urban areas with high RPU and moderate AT&C loss so that it will be effective. Later, it may be extended to other areas depending upon the success and experience achieved in the first phase.

The smart features in the Meter Data Management System (MDMS) should be used to detect the abnormal pattern of consumption on an hourly basis and take corrective measures. Moreover, the data from MDMS will help in network planning & analysis, load analysis/forecasting, peak load management, outage management, demand side management etc.

The progress of the Implementation of Smart Metering System may be reviewed once in three months by a Monitoring Committee constituted by the Commission.

----------X----------

**Annexure-I**

**Smart Meters & their Installation:**

A. Meters For Consumers

| Meter Type | Quantity | Cost Per Meter (in Rs.) (as per M/s Genus) | Total Cost (in Rs. Lakh) |
|---|---|---|---|
| Single Phase | 90000 | 3500 | 3150 |
| Three Phase | 9000 | 4000 | 360 |
| LTCT | 950 | 5000 | 48 |
| HTCT | 50 | 7000 | 4 |
| | | **TOTAL =** | **3562** |

B. Meters For Distribution Transformers

| Meter Type | Quantity | Cost Per Meter (in Rs.) (as per M/s Genus) | Total Cost (in Rs. Lakh) |
|---|---|---|---|
| LTCT meter along with Box & CT arrangement | 3000 | 8000 | 240 |
| | | **TOTAL =** | **240** |

Installation of Meters

| Meters For | Quantity | Installation Charge Per Meter (in Rs.) | Total Cost (in Rs. Lakh) |
|---|---|---|---|
| Consumers | 100000 | 500 | 500 |
| Transformers | 3000 | 1000 | 30 |
| | | **TOTAL =** | **530** |

**C. Access Points (AP) & their Installation for setting up RF Mesh:**

As one AP can aggregate the data of 4000-5000 consumers comfortably, 20-25 no. of APs are required for 1 lakh consumers. Considering 25 no. of APs along with the installation, the cost for the same is calculated below:-

| Activity | Quantity | Cost Per AP (in Rs.) | Total Cost (in Rs. Lakh) |
|---|---|---|---|
| AP & its Installation | 25 | 400000 | 100 |
| | | **TOTAL =** | 100 |

**D. System Cost (Computer Hardware, System Software, Network, HES & MDMS):**

| Item | Total Cost (in Rs. Lakh) |
|---|---|
| Computer H/W, System S/W & Networking System | 50 |
| HES & MDMS development charges + software integration charges | 250 |
| **TOTAL =** | **300** |

**E. Environment Management Cost:**

| Item | Total Cost (in Rs. Lakh) |
|---|---|
| Manpower Training & In-house Capacity Building | 80 |
| Media Campaigns, Meetings, Trainings etc. | 50 |
| Testing of Meters through Mobile Testing Vans for 4 months (Rs.30,000 / day) | 36 |
| Other Contingency / Unforeseen Expenses | 14 |

**TOTAL = 180**

**F. Total Capital Expenditure (in the first 18 months of the Project)**

| Sl. No. | Item | Total Cost (in Rs. Lakh) |
|---|---|---|
| 1 | Smart Meters & their Installation | 4332 |
| 2 | AP & their Installation for setting up RF Mesh | 100 |
| 3 | System Cost | 300 |
| 4 | Environment Management Cost | 180 |
| Sub Total | | 4912 |
| 5 | Overhead, contingency and other unforeseen expenses @ 5% of above | 245.6 |

**TOTAL Capex = 5157.6**
**or say 5158 lakh**

| | |
|---|---|
| **Financing Charge @10 % on CAPEX over life of the assets on annual rest i.e. 4332+100+300= 4732+ 5% contingency = 4968.6 x 50%** | **2484** |

**Grand Total of CAPEX = 5158+2484 = 7642 lakhs**

**Annexure-II**

**Annual Operation & Maintenance Cost**

| Sl. No. | Item | Total Cost (in Rs. Lakh) | Annual Cost in Rs. Lakh |
|---|---|---|---|
| 1 | Smart Meters for Consumers & DTRs (AMC @ 5% per annum) | 3802 | 190.00 |
| 2 | AP & RF Mesh (AMC @2.5% per annum) | 100 | 5.00 |
| 3 | HES & MDMS (Rs.14 Lakh per month x 12 months) | | 12.00 |
| 5 | Communication Charges for WAN (GPRS), Attending to repairs/ replacements/ customer complaints/ upgradation etc. | | 10.00 |
| 6 | Consultancy Charges of System Integrator | | 24.00 |
| 7 | Cost of the separate team for the SMART METERING SYSTEM | | 20.00 |
| | | Sub Total= | **261.00** |
| 8 | Overhead, contingency and other unforeseen expenses @ 10% of above | | 26.00 |
| | | **Total O& M Expenses =** | **287.00** |

**Annexure-III**

# BENEFITS TO DISCOM ON ACCOUNT OF AMI

| Sl. No. | BENEFITS | VALUE | ANNUAL SAVINGS for 1 Lakh Consumers (in Rs. Lakh) |
|---|---|---|---|
| 1 | Annual savings on meter reading cost (salary, allowances and travel cost of meter readers, stationery etc.) (A); | Rs.7/- per consumer per month considered (= 7 × 12× 1 lakh); | **84** |
| 2 | Annual savings due to faster detection of dead and defective meters in the system (taking INR 5* as average tariff) (B) | No. of dead and defective meters considered for 0.3% customers, time taken to detect dead meters as 30 days, monthly billed energy as 20 MU and billing efficiency as 90%<br>(= 66666 × 12 × 5) | **40** |
| 3 | Annual savings due to reduction in AT&C losses (taking INR 5 as avg. tariff). This includes energy accounting (C) | Reduction in AT&C losses due to SMI considered as 10% (from 30% to 20%)<br>(=10% of 20 MU × 12 × 5) | **1200** |
| 4 | Annual savings due to other efficiency improvements: (D)<br>(i) reduction in DT failure rate<br>(ii) instant consumer indexing & real time auditing of all level of supply<br>(iii) reduction in peak power purchase cost | Not Considered. | **0** |
| | **Total annual benefits (=1 +2 + 3 + 4** | | **1324** |

**Annexure-IV**

- **Performance levels for collection of daily meter readings (as per IS 16444/15959 part 2)**

The following are the performance levels required for the daily collection of the previous day's interval energy data and total accumulated energy:
(1) All interval data from 95% of meters within 8 hours after midnight; and
(2) All interval data from 99.9% of meters within 24 hours after midnight.

- **Performance levels for remote reads of individual meters if data is not received on daily basis**

The performance level of an individual read applies to the collection of seven days of interval energy data and the current total accumulated energy from a particular AMI meter whose data is not being received on daily basis. The performance level required shall be:
(1) Action performed at 90% of meters within 1 Hour;
(2) Action performed at 99% of meters within 2 hours; and
(3) Action performed at 99.9% of meters within 6 hours.

- **Performance level for remote load control commands for selected consumers,**

The performance level required for individual meters shall be:
(1) Action performed at 95% of meters within 5 minutes;
(2) Action performed at 99% of meters within 10 Minutes

- **Performance level for remote connect/disconnect for selected consumers,**

The performance level required for selected individual meters shall be:
(1) Action performed at 90% of meters within 10 minutes;
(2) Action performed at 99% of meters within 1 hour; and
(3) Action performed 99.9% of meters within 2hours.

- **Performance levels for meter loss of Supply and outage detection**

Alarms to be received within 5 minutes for 90% of meters.

- **Performance levels for remotely altering settings in meter/ firmware upgrade**

**The performance level required for individual meters shall be:**

(a) Action performed at 99% of meters within 24 hours
(b) Action performed at 99.9% of meters within 36 hours.

- **Performance levels to remotely read events logs**

Performance level for reading the full event log that pertains to an individual meter shall be:

(1) Action performed at 90% of meters within 30 minutes;
(2) Action performed at 99% of meters within 1 hour; and
(3) Action performed at 99.9% of meters within 6 hours.

- **To read the event logs pertaining to all meters:**

The data pertaining to 99.5% of meters with in 1 day;

- **Performance levels for updating of data on consumer portal/ app**

The performance level of updating of individual consumer data on portal/ app after receiving the data in MDM shall be:

(1) Action performed for 90% of consumers within 1 hour after receiving the data in MDM;
(2) Action performed at 99.5% of meters within 6 hours after receiving the data in MDM.

- **The performance level for generation of bills**

(1) Action performed at 99.5% of consumers Within 1day.
(2) The performance levels at 99.5% of consumer within 30Mins on meter discovery time line after installation, on demand reading of meter data for operational purposes, outage restoration enquiry response time etc. would also be declared by the bidder.

Additionally, the Disaster Management timelines in terms of Recovery Time Objective (RTO) and Recovery Point Objective (RPO) of HES have to be defined by the bidder.