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Power Sector Skill Council

TRAINING GUIDE FOR
SMART METER
INSTALLER TECHNICIANS

Developed Under

SOUTH ASIA REGIONAL ENERGY PARTNERSHIP (SAREP)

MAY 2023

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ACKNOWLEDGEMENT

Apurva Chaturvedi
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USAID/India

USAID is grateful to the leadership of Mr. Vishal Kapoor, **CEO, EESL (former** Joint Secretary (Distribution), Ministry of Power (MoP), Government of India); and guidance of Mr. Saurav Kumar Shah, Executive Director (IPDS), Power Finance Corporation Limited (PFC) in identifying the training requirement for the smart meter installer technicians.

USAID is thankful to **Late Mr. Ravi P.** Singh, CEO, Power Sector Skill Council (PSSC) for his guidance and support in producing this training guide.

I would like to thank the SAREP team, comprising Mr. **Rakesh Goyal,** Mr. Sumedh Agarwal, Mr. Ajay Rawat, Mr. Vinod Bihari, Mr. Anil Garg, and Ms. Anindya Upadhyay, for their support in developing this 'Training Guide for Smart Meter Installer Technicians' and also in training the trainers who will eventually impart training to the technicians.

I wish to acknowledge the contributions of experts, including Mr. Nagendra Shekhar, Mr. Ravi Malik from BSES Rajdhani Power Ltd, and Mr. Subhadip Ray Chaudhury from Tata Power-DDL, for their time and effort in preparing this training guide.

I sincerely hope this document supports and contributes to the Government of India's goals to strengthen the Indian power distribution sector through the development of a skilled workforce for the deployment of 250 million smart meters in the country.

FOREWORD

John Smith-Sreen
Director, Indo-Pacific Office,
USAID/India

South Asia is one of the fastest growing regions in the world and energy plays a significant role in its development. Ensuring access and availability of energy, especially in the form of electricity, is central to sustaining the region's expanding economies and important to support people's rising aspirations. The United States Agency for International Development (USAID) supports India's power distribution industry in implementing advanced technologies to meet these energy goals.

Smart meters, one such technology, have the potential to transform distribution utilities' business processes by improving power supply reliability, operational efficiency, and customer satisfaction. Smart meters empower utilities with real-time data on power consumption and enable customers to make informed choices about their electricity use. Smart meters are a key building block in establishing a smart grid.

Recognizing these benefits, India's Ministry of Power recently announced the Revamped Distribution Sector Scheme (RDSS), an initiative to roll out 250 million prepaid smart meters through state-owned utilities. This initiative is the largest such program in the world and requires a highly skilled workforce.

As the first point of contact for utility customers, smart meter installers must understand the technology, the benefits smart meters offer consumers, and the available communication tools. Smart meter technicians need to carry out installations safely and respond knowledgeably to customer inquiries.

This training guide, jointly developed by the Power Sector Skill Council (PSSC) and USAID, will serve as a valuable resource in equipping technicians with best practices to support India's nationwide smart-meter deployment. Not only does the guide focus on developing technicians' expertise, but it provides comprehensive suggestions to enhance customer experience.

Smart meters contribute directly to the climate priorities of USAID's recently launched South Asia Regional Energy Partnership (SAREP). Among these climate priorities, SAREP will help modernize utilities and advance emerging clean-energy solutions.

In closing, I would like to commend the USAID and PSSC teams for their excellent work on this training guide. By supporting India's smart-meter rollout, both technicians and consumers will help to ensure a successful deployment under RDSS, which will ultimately accelerate access to affordable, reliable, and sustainable energy in South Asia.

MESSAGE

Prafulla Pathak
Secretary
Power Sector Skill Council

PSSC promoted by Ministry of Power (Central Electricity Authority), Ministry of Power, Govt. of India, Ministry of New & Renewable Energy (MNRE), Govt. of India and Indian Electrical & Electronics Manufacturers' Association (IEEMA) mandated to facilitate the cause of skill development across power sector to ensure availability of readily certified workforce for employable across job roles covering areas of Power Generation, Transmission, Distribution, Distribution Downstream, Renewable Energy, Power Equipment Manufacturers etc. PSSC was to ensure availability of readily employable skill-trained and certified workforce, eventually benefit-ting the power utilities, manufacturers, and other organizations.

Deployment of smart metering can be a game-changer in making DISCOMs financially sound by raising their operational efficiency. Taking cognizance of the same, the Government of India (GOI) recently announced the Revamped Distribution Sector Scheme (RDSS), which mandates the implementa-tion of prepaid smart meters in a time-bound manner across the country.

The role of the Power Sector Skill Council (PSSC) in the RDSS is to improve human and institutional capacity and this objective is very well reciprocated by the USAID under their South Asia Regional Energy Partnership (SAREP) by developing this training guide for smart meter installer technicians.

The training guide for smart meter installer technicians has been developed in partnership with the SAREP team for capacity building of the workforce required for the above-mentioned roll-out of smart meters. In addition to capturing the best practices of conducting the field activities, there is an emphasis on the safety of the technician and the consumer. Furthermore, with detailed consumer engagement templates available in the manual the objective of enhanced consumer experience can be achieved.

I would like to take this opportunity to appreciate the excellent work done by the USAID/I and PSSC teams in developing this training guide. I hope this document accomplishes building manpower capacity for the successful roll-out of smart meters under India's RDSS program.

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LIST OF ACRONYMS AND ABBREVIATIONS

ABC	Aerial Bunched Cable
AC	Alternating Current
AMI	Advanced Metering Infrastructure
AMP	Ampere
AMR	Automatic Meter Reading
BIS	Bureau of Indian Standards
CEA	Central Electricity Authority
CERC	Central Electricity Regulatory Commission
CIS	Customer Information System
COSEM	Companion Specification for Energy Management
CT	Current Transformer
DCU	Data Concentrator Units
DER	Distributed Renewable Energy
DLMS	Device Language Message Specification
DT	Distribution Transformer
EHV	Extra High Voltage
ELCB	Earth-leakage Circuit Breaker
ERP	Enterprise Resource Planning
EV	Electric Vehicles
FFA	Field Force Automation
GIS	Geographic Information System
GPRS	General Packet Radio Service
HES	Head End System
HT	High Tension
HVDS	High Voltage Distribution System
Hz	Hertz
IC	Incoming
IHD	In-Home Display
IS	Indian Standards
IT	Information Technology
IVR	Interactive Voice Response
JSA	Job Safety Analysis
kVAh	Kilo Volt Ampere Hour
kWh	Kilo Watt Hour
LCD	Liquid Crystal Display
LED	Light Emitting Diode
LoRa	Low Power Long-Range Wireless
LT	Low Tension
MCB	Miniature Circuit Breaker
MCCB	Molded Case Circuit Breaker
MD	Maximum Demand
MDMS	Meter Data Management System
mm	Millimeter
Mtr/m	Meter
MWM	Mobile Workforce Management
NAN	Neighborhood Area Network
NIC	Network Interface Card
OEM	Original Equipment Manufacturer
OHSAS	Occupational Health & Safety Standards
OMS	Outage Management System
Pa	Pascal
PLC	Power Line Carrier/Communication
PPE	Personal Protective Equipment
PSTN	Public Switched Telephone Network
PT	Potential Transformer
PV	Photovoltaic
PVC	Polyvinyl chloride
PWD	Public Works Department
RCCB	Residual Current Circuit Breaker
RF	Radio Frequency
RTC	Real Time Clock
SMNP	Smart Meter National Program
SOP	Standard Operating Procedure
ToD	Time of Day
ToU	Time of Use
V	Volt
WAN	Wide Area Network


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1. BACKGROUND

The recently launched Revamped Distribution Sector Scheme (RDSS) by the Government of India (GoI) supports implementation of pre-paid smart meters and system metering, which is key to strengthening power distribution companies (Discoms), both operationally and financially. Smart meters can help Discoms by:

i) improving collection efficiency of Discoms

ii) reducing working capital requirements by encouraging advance collection of charges

iii) enabling rapid detection of outages and losses in the system

iv) enhancing service quality

v) improving load and demand management

vii) producing loss-reduction initiatives

viii) enabling consumer participation in demand response that further helps with time-of-day billing, peak shaving, generating consumption-data analytics, and better load switching

The rollout of smart meter technology also entails upskilling a large workforce. Technicians will require solution-specific training, in addition to know-how on installation, commissioning, operations and maintenance (O&M), and command-center operations.

Smart meter installers would represent the largest group involved in the transformation of metering infrastructure of distribution utilities and will be crucial for meeting the government's targets. As per estimates, approximately 25,000-30,000 installers would be required for 100 million smart meters by 2023 under RDSS.

One of the objectives of the South Asia Regional Energy Partnership (SAREP) is to support the modernization of utilities. SAREP has identified capacity building of utilities as one of its key interventions and consequently collaborated with the Power Sector Skill Council (PSSC) to develop a training guide for smart meter installers.

This training guide has been prepared by utilizing the knowledge base available with USAID and stakeholders from industry and the academia. SAREP and PSSC have also conducted stakeholders' workshops to review and finalize the content.

Installers would be the first point of contact for consumers for replacement of conventional meters. Therefore, the training guide also focusses on the significance of consumer engagement during the meter installation process, in addition to addressing technical content.

The training guide also deliberates in detail on the aspect of operational safety and emphasizes the use of appropriate tools and protective equipment for the safety of installers and users alike.

This guide can be utilized both by power distribution companies as well as smart meter installation agencies for building capacity of their workforce to deploy the technology. It is divided into four parts:

A: Essential reading

- Introduction to smart meter
- Smart meter components and types
- Functional requirements of smart meter
- Different communication channels utilized by smart meters
- Smart meter specifications

B. Standard operating procedure for smart meter installation and commissioning

- Workflow during the smart meter installation and commissioning
  - o Pre-installation activities
  - o Installation related activities
  - o Post-installation activities
- Operation and maintenance activities post installation

C. Consumer-engagement guide

- Significance of consumer engagement
- Smart meter components and types

D. Assessment criteria and sample questions for assessing smart meter installer

- Theory questions
- Viva questions
- On-job training questions

PART I

ESSENTIAL READING

2. INTRODUCTION TO SMART METER

2.1 WHAT IS A SMART METER?

Electromechanical analog meters are used to operate on the mechanism of counting the revolution of the metal disc rotating in the proportion of electrical power passing through the meter. Later, electronic meters with digital displays were used for power consumption. Then AMR (automatic meter reading) was used for automatically fetching the meter readings. The advancement of AMR is a smart meter with bi-directional communication between the smart meter and the server.

A smart meter has the following features:

- Is an electronic device that records information such as consumption of electricity, voltage levels, currents, and power factor
- Smart meters enable two-way communication between the meter and the central system. Communicates the information to the consumer, providing greater clarity in consumption behavior, and to electricity suppliers for system monitoring and customer billing
- Communications are either via wireless or via fixed-wired connections such as power line carriers (PLCs)
- Wireless communication options in common use in India include cellular networks, wi-fi, wireless ad hoc networks over wi-fi, radio frequency (RF)

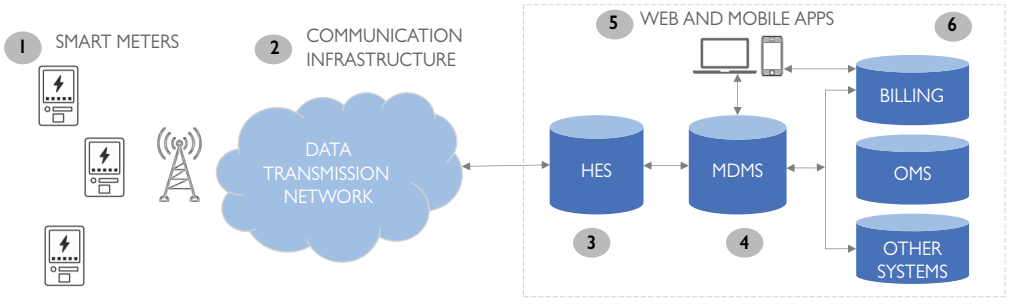
Smart meters and conventional electronic meters are more accurate and precise than electromechanical meters. The smart meter has the advantage over conventional electronic meters as in addition to recording energy usage in nearly real-time, it reports regularly at short intervals throughout the day to the utility and the consumer.

2.2 SMART METERING INFRASTRUCTURE COMPONENTS

The smart metering infrastructure primarily includes the following key components[1] :

a. Smart meters
b. Communication infrastructure
c. Head end system (HES)
d. Meter data management system (MDMS)
e. Web application with updated online data about consumers
f. Mobile app for consumers

FIGURE 1: SMART METERING INFRASTRUCTURE



[1] Source: Functional Requirements of Advanced Metering Infrastructure (AMI) in India by Central Electricity Authority (CEA) - https://www.ipds.gov.in/Whats_New_Files/ami_func_req-Aug%202016.pdf last accessed on 27th December 2021

Key attributes of smart metering infrastructure components include:

1. **Smart meters** must comply with the technical specifications notified by CEA or other relevant authority

2. **Communication infrastructure** is either based on a radio frequency (RF) mesh network/PLC, cellular network, or a combination of these. The communication network should comply with the standards of neighborhood area network (NAN) and wide area network (WAN). The communication network provides a reliable medium for two-way communication between various nodes (smart meters) and the head-end system (HES)

3. **The head-end system (HES)** is the component of an AMI infrastructure that communicates with smart meters in the field. HES acquires meter data automatically without the need for human intervention

4. **Meter data management system (MDMS)** is a single storehouse of meter-related data (billing, settlements, demand forecasting, makes the data available, etc) that gathers data from multiple head-end systems and make the data available for billing; consumer information system; customer care; reporting; network planning and analysis, load analysis and forecasting; and outage `management, etc.

5. **A web application** or data portal makes data collected in the MDMS available to anyone who needs it. The web portal provides the consumer with almost real-time views of electricity use and cost, as well as alerts, notifications, and energy-savings tips. Customers and utilities can also view past electricity usage (daily, weekly, monthly, annual, etc.)

6. **The mobile app** supported by the MDMS allows the consumer to log in via Android/iOS/ Windows mobile apps to see relevant information. The app also provides a platform for the implementation of peak load-management functionality, by showing consumers existing tariffs, incentives, and participation options

2.3 ADVANTAGES OF SMART METER

2.3.1 ADVANTAGE OF SMART METER TO THE CONSUMERS

Smart metering offers many potential benefits to consumers which include the following:

a. Eliminating the need for estimated bills, a major source of complaints from consumers

b. Benefiting consumers via more accurate and timelier bills

c. Empowers customers with the information they need to become energy-savvy and make smarter decisions about energy usage

d. Helping consumers efficiently manage their energy purchases, via an app that displays real-time energy usage

e. Giving customers greater control over their electricity use, coupled with time-based rates that enable savings

f. Allowing customers to make informed decisions by providing highly detailed information

g. Providing real-time alerts to consumers about power availability

h. Enabling faster outage detection and restoration of service

i. Helping the environment, by reducing the need to build power plants or avoiding the use of older, less efficient power plants as customers lower their electric demand

j. Increasing privacy, as periodic electricity usage information can be relayed automatically to the utility for billing purposes, without an on-site visit by utility personnel

k. Allowing consumers to switch between conventional, renewable, and battery-based sources, based on prevailing tariffs

l. Measuring electricity generated from domestic microgeneration, enabling consumers to be financially rewarded for their contributions

2.3.2 ADVANTAGES OF SMART METERS TO THE UTILITIES

a. Reducing meter reading costs as meters are read remotely

b. Enabling timely billing to improve the revenue management

c. Lowering the cost to service customers via increased customer self-service (fewer bill queries and complaints will reduce the need for site visits)

d. Allowing system faults to be notified and located more quickly, following power cuts and interruptions

e. Helping utilities better understand power grid needs, facilitating better system planning

f. Increasing load management during peak load times, ensuring more efficient use of grid resources

g. Improving the ability to deploy advanced tariff regimes and other demand-side management initiatives, optimize power procurement costs and improve load management

h. Supporting energy accounting, leading to more accurate measurements of distribution losses

2.4 GOI INITIATIVES

The Government of India (GoI) plans to replace 250 million existing meters with smart meters by 2022 under the Smart Metering National Program (SMNP). The Ministry of Power (MoP) has already accelerated the implementation of pre-paid smart meters through policy mechanisms and support from the EESL BOOT model with no upfront investment required by utilities. With electricity demand expected to rise by 79 percent over the next 10 years, smart meters will also significantly reduce the Aggregate Technical and Commercial (AT&C) losses[2].

The recently launched Revamped Distribution Sector Scheme (RDSS) aims at:

(i) Reduction of AT&C losses to pan-India levels of 12-15% by FY 2024-25

(ii) Improvement in the quality, reliability, and affordability of power supply to consumers through a financially sustainable and operationally efficient distribution sector. In order to achieve the objectives, the schemes are structured into two parts: Part A – Financial support for Prepaid smart metering and system metering and up-gradation of the distribution infrastructure; Part B – Training and capacity building and other enabling and supporting activities

The support under Part A includes activities related to smart/prepaid meter installation. Some of the highlights of this support are:

- Prepaid smart metering to be prioritized for
  - o 500 AMRUT[3] cities, with AT&C Losses >15%
  - o All Union Territories

[2] AT&C is the sum of technical and commercial losses and shortage due to non-realization of billed amount. AT&C Losses = *{1 - (Billing Efficiency X Collection Efficiency)} × 100; where Billing Efficiency= Total unit Billed/ Total unit Inputs; and Collection efficiency = Revenue collected / Amount Billed.*

[3] The GoI has launched the Atal Mission for Rejuvenation and Urban Transformation (AMRUT) with the aim of providing basic civic amenities like water supply, sewerage, urban transport and, parks, to improve the quality of life for all, especially the poor and disadvantaged.

- MSMEs (Micro, Small, and Medium Enterprises), Industrial and Commercial consumers
- All Government offices at the Block level and above
- Other areas with high losses

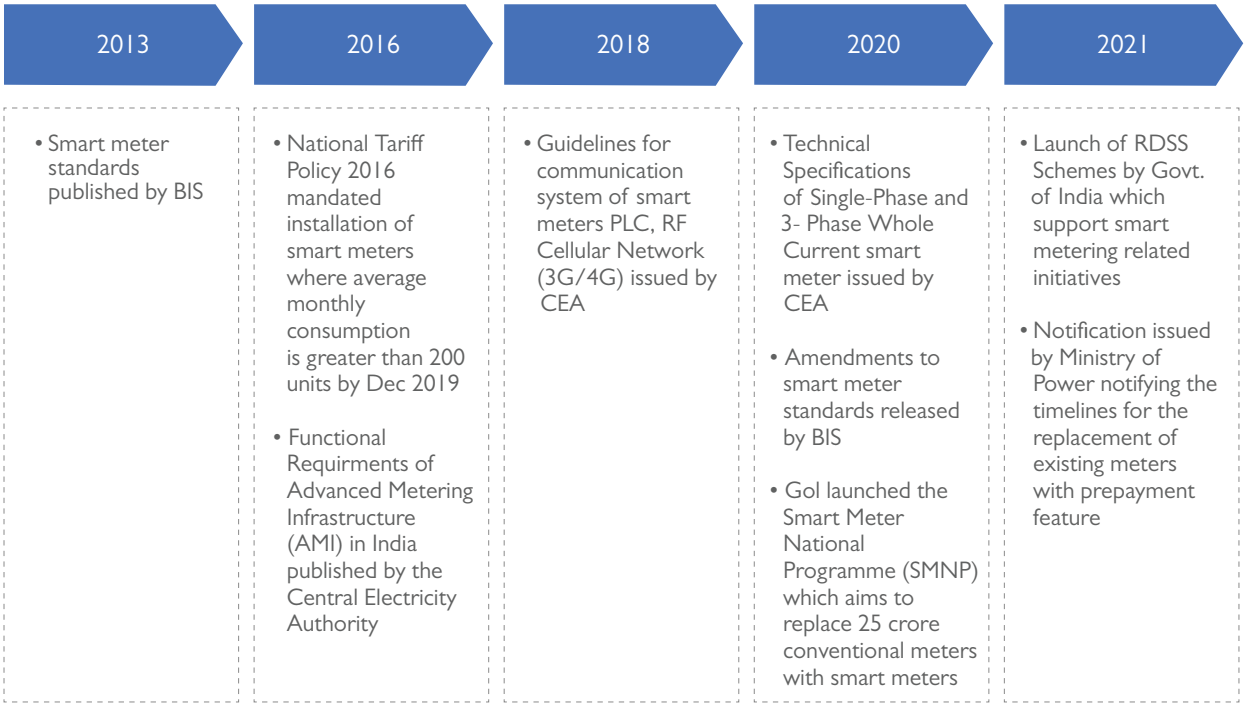
- Prepaid smart metering for remaining consumers and areas to be undertaken by the respective discoms, in a phased manner
- Support for implementation of prepaid smart meters and system metering in areas with high losses, and subsequently rolled out in phases

Financial support is also envisaged for the installation of smart meters under RDSS in the following manner:

- For prepaid smart metering, a grant of INR 900 or 15% of the cost per consumer meter (whichever is lower) will be available for "other than special category" states. For "special category" states, the grant of INR 1350 or 22.5% of the cost per consumer (whichever is lower) will be available
- To incentivize the States/UTs to fast-track installation of prepaid smart meters by December 2023, an additional incentive of 7.5% of the cost per consumer meter or INR 450 (whichever is lower) will be available. For "special category" states the additional incentive will be 11.25% or INR 675 per consumer meter (whichever is lower)

Several steps have been taken by the GoI to encourage and facilitate the deployment of smart meters, outlined in the figure below.

FIGURE 2: STEPS TAKEN BY THE GOI FACILITATING THE DEPLOYMENT OF SMART METER



2.4.1 SMART METER DEPLOYMENT IN INDIA

Smart meters are being deployed in various states like Uttar Pradesh; Rajasthan; Bihar; Haryana; Andaman and Nicobar, Assam, and West Bengal. Till December 2021, around 3.4[4] million smart meters have been installed by the state-owned utilities or through EESL.

3. SMART METER: COMPONENTS AND TYPES

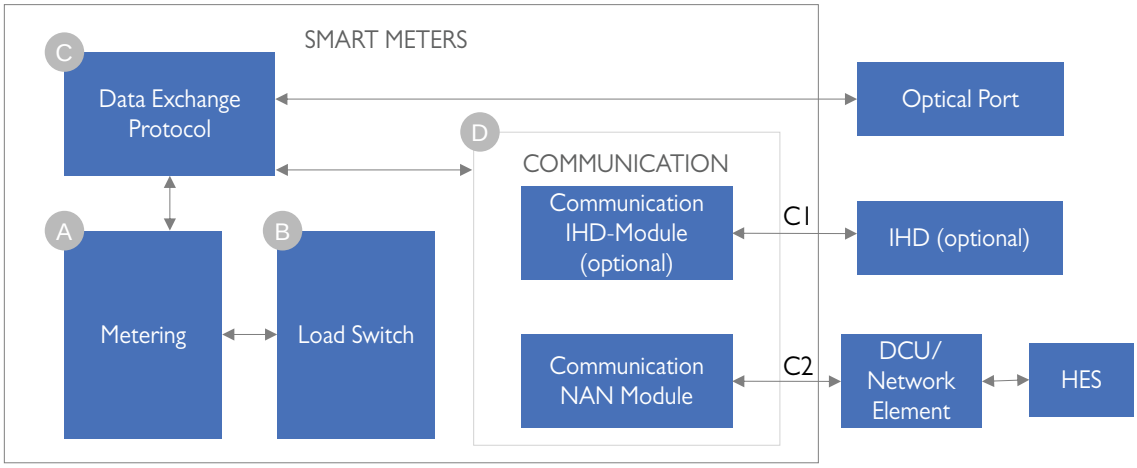
3.1 SMART METER ARCHITECTURE

The smart meter is a component of AMI comprising of following functional zones:

- Metering
- Load switch
- Metering protocol
- Communication modules

Smart meter features can be selected to match overall system and site conditions. To facilitate this flexible approach, the mandatory communication modules for smart meter architecture come in two types: Neighborhood Area Network (NAN) or Wide Area Network (WAN). These two variants are diagrammed in the figures below:

FIGURE 3: VARIANT 1



A: Metrology; B: Load switch for control; C: Data exchange and metering protocol *Source: BIS 16 444*

LEGEND

A – Metrology

B – Load switch for control

C – Metering protocol

D – Communication

Optical port — As per IS 15959 (Part 2)

C1 – IHD Connectivity SM ⟷ IHD (optional)

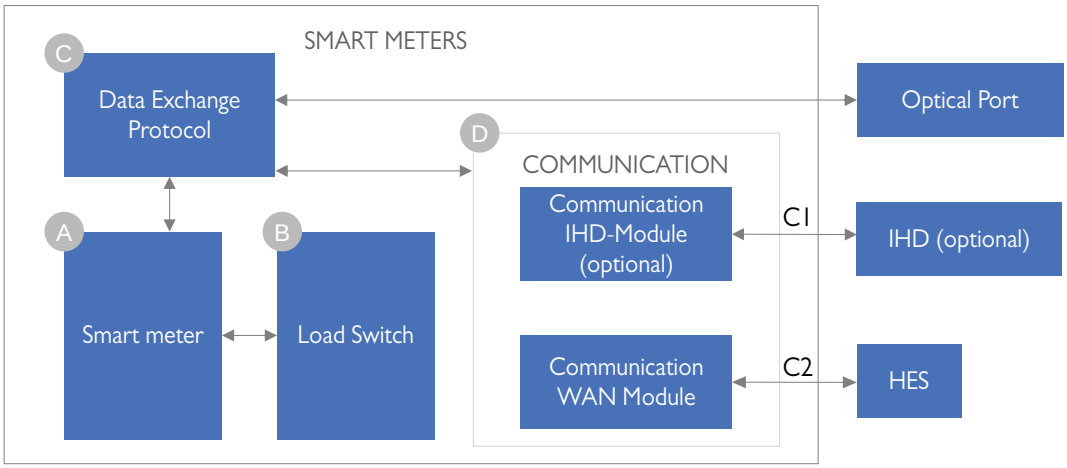
C2 – NAN Connectivity SM ⟷ DCU

NOTES

- Smart meter variant 1 provides connectivity C2 for two-way communication with DCU using a NAN module
- If in-home display (IHD) is chosen, the smart meter will provide connectivity C1 for two-way communication with IHD using the same NAN module or a suitable additional module as per the utility/meter seller/manufacturer agreement

[4] Smart Metering Status: National Smart Grid Mission (NSGM) portal- https://www.nsgm.gov.in/en/sm-stats-all, last accessed on 27th December 2021

FIGURE 4: VARIANT 2



A: Metrology; B: Load switch for control; C: Data exchange and metering protocol *Source: BIS 16 444*

LEGEND

A – Metrology

B – Load switch for control

C – Metering protocol

D – Communication

Optical port — As per IS 15959 (Part 2)

C1 – IHD Connectivity SM ↔ IHD (optional)

C2 – NAN Connectivity SM ↔ DCU

NOTES

i. Smart meter variant 2 provides connectivity C3 for two-way communication with HES using a WAN module

ii. If IHD is chosen, the smart meter will provide connectivity C1 for two-way communication with IHD using a suitable additional module, as per utility/meter seller/manufacturer agreement

The difference between the variants is communication technology. In the case of Operation & Maintenance activities and especially the case of Non-communication with HES, it is desirable for the technician to be aware of the different communication technologies are available for smart meters.

3.2 SMART PRE-PAID METERS

3.2.1 HOW ARE SMART PREPAID METERS DIFFERENT

Prepaid meters benefit the end-users by avoiding unexpected bills as smart prepaid meters allow users to budget their electricity usage because they can monitor their usage. The ability to monitor electricity usage means usage patterns can be observed and users can gain an understanding of what appliances and usage patterns affect their consumption the most. This gives consumers more control over their electricity usage and enables them to budget for electricity each month with less likelihood of being surprised by a larger than normal bill. Smart meters also enable monitoring of consumption, however, the impact on billing is known only after the completion of the billing cycle.

3.2.2 HOW DO SMART PREPAID METERS WORK

- The consumer can recharge the account from the vending outlets
- There are also online mobile recharge options available to recharge the account (e.g. Paytm, BillDesk, etc.)
- The utility informs the consumers about the balance amount at various levels of the remaining balance and stops the supply once the balance is consumed. However, disconnection will not happen on weekends, holidays, and during night hours
- Smart meters allow a greater degree of control and drastically reduce the probability of tampering. They also make meter reading more efficient and managing the connection and disconnection of supply easier

3.2.3 BENEFITS OF PREPAID METERS

Benefits to end customers

- Flexibility to preplan budget for paying utility bills
- No fixed charges, irrespective of consumption, in the case of prepaid metering options, which is ideal for consumers who use electricity intermittently
- No additional charges for reconnection
- No need to pay the security deposit to access services
- Improved customer service, with control left to the customer
- Ease of recharge, through various options offered by utilities
- Some utilities provide rebates or incentives to the consumers opting for pre-paid connection over a post-paid connection

Benefits to utility

- No issues related to payment default by consumers
- Reduced paperwork, as consumers do not have to be billed manually, and reduction in the cost of meter reading
- Encourages consumers to better manage energy consumption
- The upfront collection helps reduce working-capital requirements
- Enhanced call-center efficiency, due to reduced customer complaints

3.3 SMART METER FUNCTIONAL REQUIREMENT

The smart meter is developed as per the standard which is required to support the handling of the following operational requirement[5].

[5] Source: Technical Specifications of Single-phase whole current Smart Meter by Central Electricity Authority (CEA)- https://-cea.nic.in/wp-content/uploads/2020/04/Tech.-Specification-of-Smart-Meters-1-Ph-and-3-Ph-Feb-2020.pdf last accessed on 27th December 2021

3.3.1 DISCONNECTION MECHANISM

- Over current (minimum 105% of Imax in any phase for predefined persistence time)
- Load control limit (programmable and set by utility)
- Pre-programmed event conditions (factory set)
- Disconnect signal from the utility control center
- In the case of the pre-paid facility under defined/agreed conditions

3.3.2 RECONNECTION MECHANISM

Local reconnection after disconnection due to over-current or load control limit proceeds as follows:

a) Switch re-connection is decided by the meter locally. The meter will attempt to reconnect the load up to a predefined time, with predefined intervals (times and intervals are programmable by the utility). If consumption is within limits, the meter will remain in normal connect mode

b) If consumption is still more than programmed limits, the meter will lock out for 30 minutes (lockout period). After this period, the meter will reconnect the load, and if consumption is still above the limit, the procedure in a) is repeated with a status update to HES

c) In all conditions other than the over-current and load-control limit, reconnection will be done from HES. In case of failure of communication with HES, reconnection will be possible through an optical port, locally, with specified security

3.3.3 STATUS OF LOAD SWITCH

The status of the load switch (connected/ disconnected) is available on the display, as well as at HES. All connections and disconnections are logged as events.

3.3.3.1 LAST GASP

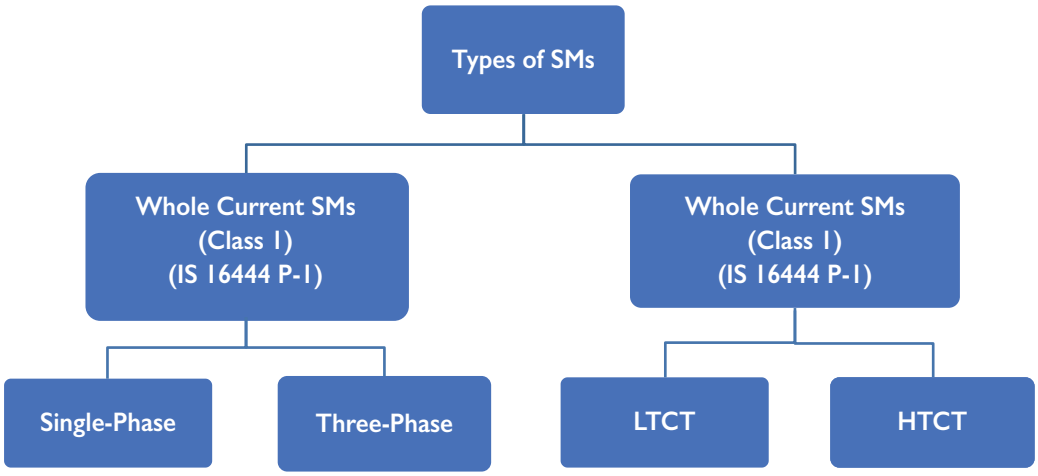
This is a notification from the smart meter that it is not receiving electricity from the grid.

3.3.3.2 FIRST BREATH

This is a notification from the smart meter that is now receiving electricity from the grid.

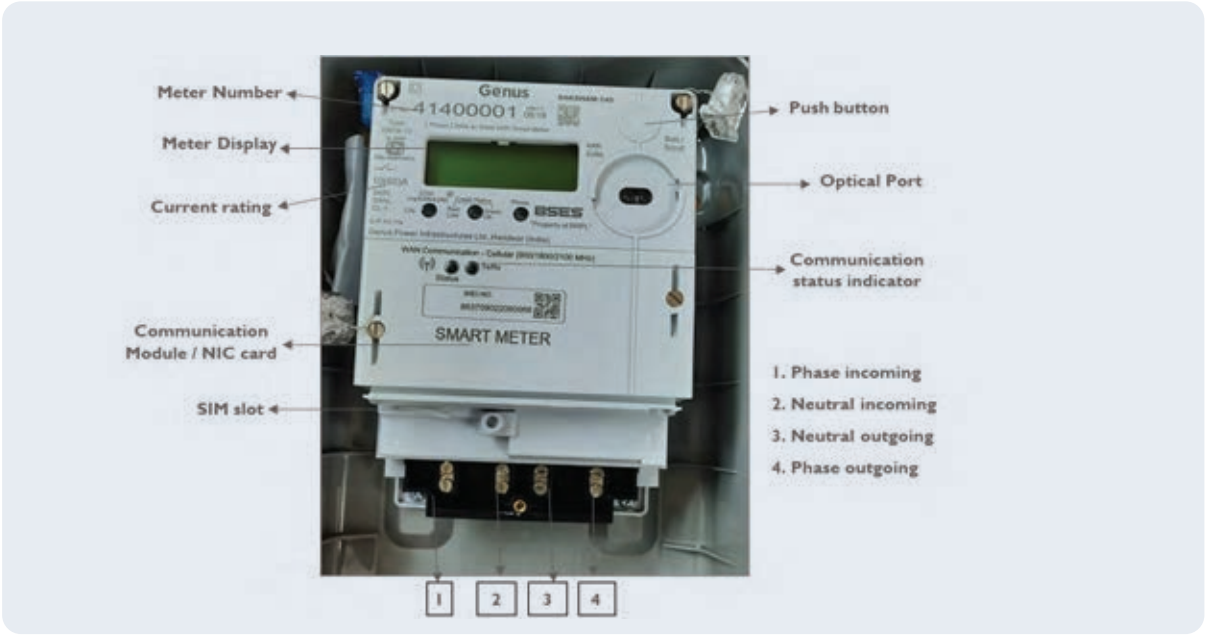
3.4 TYPES OF SMART METER

FIGURE 5: TYPES OF SMART METER



3.5 NAME PLATE

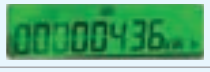
FIGURE 6: ILLUSTRATIVE NAME PLATE OF THE SMART METER

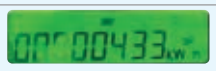
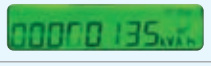


Source: BSES Rajdhani Power Ltd

3.6 DISPLAY PARAMETER OF SMART METER

TABLE 1: ILLUSTRATIVE DISPLAY PARAMETERS OF THE SMART METER

S. No.	Display parameters	HPL smart meter	Schneider smart meter
1	LCD Check		
2	Meter serial number		
3	Tamper/Ok		
4	Date		
5	Time		
6	Cumulative kWh		
7	Cumulative kVAh		
8	TOD cumulative kWh T1		
9	TOD cumulative kWh T2		
10	TOD cumulative kWh T3		

S. No.	Display parameters	HPL smart meter	Schneider smart meter
11	TOD cumulative kVAh T1		
12	TOD cumulative kVAh T2		
13	TOD cumulative kVAh T3		
14	Current month MD kW		
15	Current month MD kVA		
16	Last month (history1) kWh		
17	Last month (history1) kWAh		
18	Last month (history1) TOD Cumulative kWh T1		
19	Last month (history1) TOD Cumulative kWh T2		
20	Last month (history1) TOD Cumulative kWh T3		
21	Last month (history1) TOD Cumulative kVAh T1		
22	Last month (history1) TOD Cumulative kVAh T2		
23	Last month (history1) TOD Cumulative kVAh T3		
24	Last month (history1) MD kW		
25	Last month (history1) MD kVA		
26	Phase current		
27	Neutral current		
28	Instantaneous voltage		
29	Instantaneous phase load		
30	Instantaneous neatural load		
31	Status of load switch (connect or disconnect)		
32	Communication status of the mete	Not Available	

Source: Tata Power - DDL

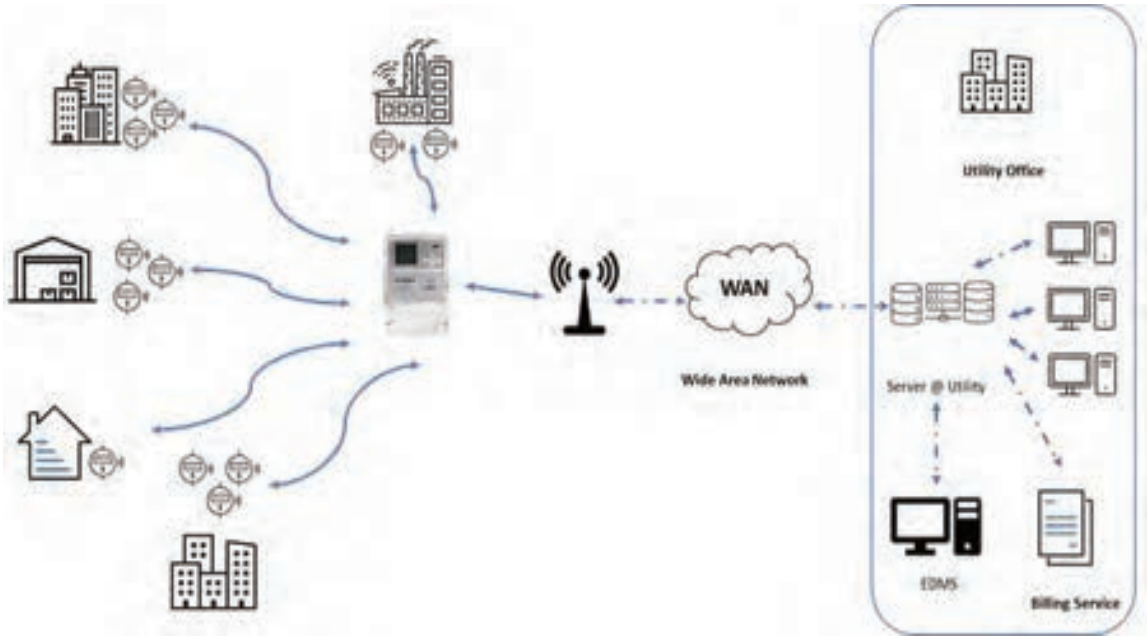
4. HOW SMART METERS COMMUNICATE

Different types of communication channels enable communication between smart meters and systems installed at the utility.

4.1 CELLULAR NETWORK- GPRS/3G/4G TECHNOLOGY

The mobile telecommunication technology evolved from GPRS to 3G to 4G and expected to 5G in coming years. It uses packet-switched data rather than circuit-switched data, which allows more- efficient use of available capacity. Transfers occur in short peaks, followed by breaks when there is little or no activity. Cellular is the first real evolution in global system for mobile communications (GSM), and the first to provide real data capability. It enables emails and some simple web browsing, though speeds are still very slow compared to modern standards.

FIGURE 7: CELLULAR NETWORK TECHNOLOGY ILLUSTRATION



This wireless network has expanded to many small towns and villages in India. Many countries have used 3G technology in smart meters successfully transferring data to the central servers of utilities.

This is the most suitable technology for smart meters, because of the widespread existing network of mobile operators for handling data. Utilities are spared the maintenance of communication networks; however, they must pay monthly rental/data charges for use of the network, which comprises a significant part of the meter's operating cost. Cellular provides data at faster speeds and is beneficial in cities where competition between service providers ensures lower costs, along with good network reach. However, there may be data delays/losses in remote areas and villages where network strength is poor. Another challenge relates to the obsolescence of this technology in the long run, which impacts the maintenance of communication modems and chips, along with rental charges, which may affect the overall operational budgets of utilities.

4.2 RF MESH COMMUNICATION

Radio frequency (RF) lies in the range from around 20 kHz to 300 GHz; these frequencies are used in radio communications. With the "mesh" concept the meters can talk to each other which means that each smart meter doesn't need to connect to a concentrator to relay data to the server. This increases reliability by providing more potential routes for data to transmit.

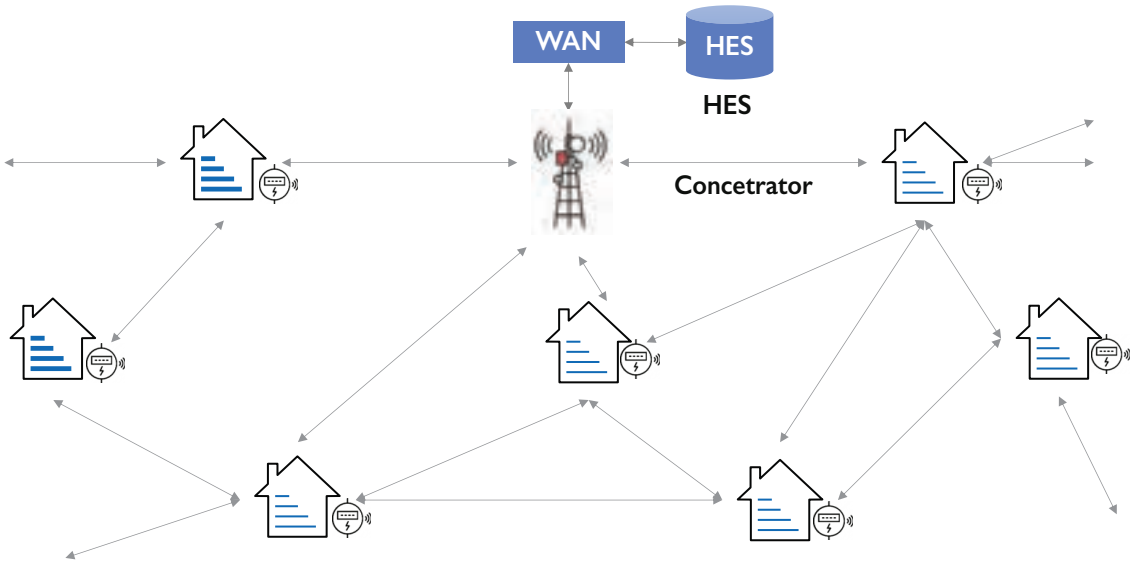
India uses the following free bands:

- **Frequency Band: 865-867 MHz**
  - o Use: Low power RFID equipment
  - o Equipment Power: Maximum transmitter output power of 1 Watt (4 Watts Effective Radiated Power)
  - o Carrier Bandwidth: 200 kHz

- **Frequency Band: 2.40-2.4835 GHz**
  - o Use: Low power equipment
  - o Equipment Power: Maximum transmitter output power of 1 Watt (4 Watts Effective Radiated Power)
  - o Carrier Bandwidth: spectrum spread of 10 MHz or higher

- **Frequency Band: 5.825-5.875 GHz**
  - o Use: Low power equipment
  - o Equipment Power: Maximum transmitter output power of 1 Watt (4 Watts Effective Radiated Power)
  - o Carrier Bandwidth: spectrum spread of 10 MHz or higher

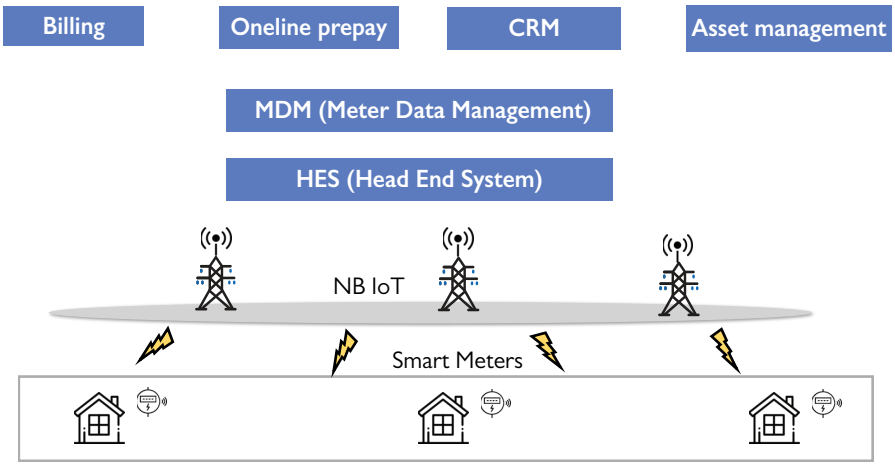
FIGURE 8: RF MESH ARCHITECTURE - ILLUSTRATIVE



4.3 NB-IOT TECHNOLOGY

Narrowband (NB) – Internet of Things (IoT) is a new technology that is both 4G and 5G compatible offering a dedicated channel for smart metering and avoiding any reduction in performance from interference or obstruction due to congestion on the public network.

FIGURE 9: NB-IOT TECHNOLOGY ARCHITECTURE- ILLUSTRATIVE

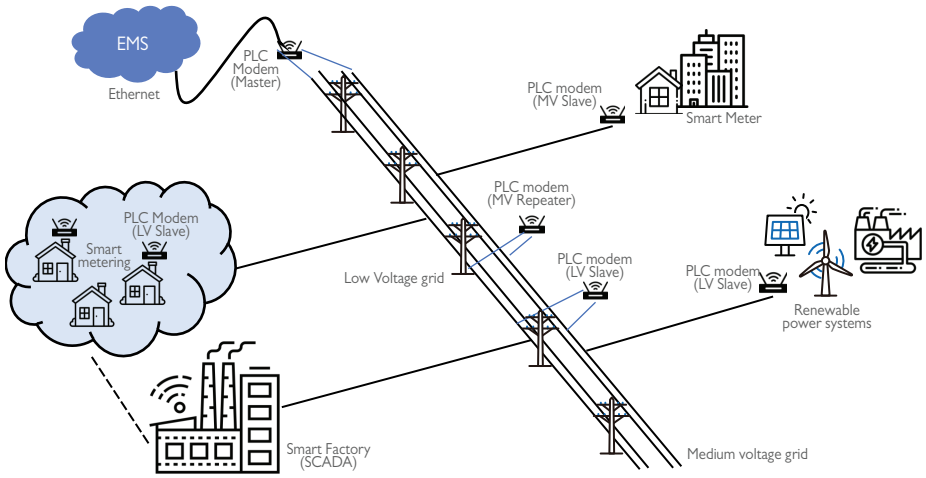


4.4 POWER LINE COMMUNICATION (PLC)

Power-line communication (PLC) carries data across the same power line used to deliver electricity. The major advantage of PLC is that it is effectively free. Limitations of this technology include:

- Slower data transfer
- Communication can be interrupted during operations of switches and disconnections in the electrical system
- Distortion of signals while passing through power transformers, inductors, etc

FIGURE 10: PLC FRAMEWORK



Amongst all the above-mentioned communication technologies, Cellular is more widely used as it is easy to scale and helps the utilities to cover non-contiguous connections. RF mesh is used in high-density areas where the cellular signal is finding difficult to penetrate and PLC is scarcely used as it requires very good electrical infrastructure to transmit the signal.

5. SMART METER SPECIFICATIONS AND STANDARDS

5.1 SPECIFICATION

The specifications of single-phase whole-current smart meters and three-phase whole-current smart meters are governed by CEA regulations issued in February 2020.

TABLE 2: KEY SPECIFICATIONS OF SINGLE-PHASE WHOLE CURRENT METER[6]

Description	Requirement
Type of meter	AC whole current, single-phase, two-wires smart energy meter with bidirectional communication facility and remote connect / disconnect switch
Rated current	For single-phase, Ib (Imax) A= 5(30)A or 10(60)A Withstands 120% Imax
Starting current	0.2% Ib connection through current transformer
Reference voltage	240 V
Frequency	50 Hz +/- 5%
Load contactor	Latching relay (optional)
Display	LCD
LED indicator	Needed (ex. line, tamper, export, kWh, etc.)
Communication port/method	GSM/Wi-Fi or PSTN, GSM, or GPRS, Radio, Zigbee,
Communication protocol	DLMS, COSEM

TABLE 3: KEY SPECIFICATIONS OF THREE-PHASE WHOLE CURRENT METER[7]

Description	Requirement
Type of meter	AC whole-current three-phase four-wire smart energy meter with bidirectional communication facility suitable for AMI, with connect/disconnect switch
Rated current	For three-phase, Ib (Imax) A= 10(60)A Withstands 120% Imax
Starting current	0.2% Ib connection through current transformer.
Reference voltage	240 V between line and neutral
Frequency	50 Hz +/- 5%
Load contactor	Latching relay (optional)
Display	LCD
LED indicator	Needed (ex. line, tamper, export, kWh, etc.)
Communication port/method	GSM/Wi-Fi or PSTN, GSM, or GPRS, Radio, Zigbee,
Communication protocol	DLMS, COSEM

[6] Source: Smart meter standards by Bureau of Indian Standards (BIS): IS16444, IS15959(1), IS15959(2)
[7] Source: Smart meter standards by Bureau of Indian Standards (BIS): IS16444, IS15959(1), IS15959(2)

PART II

METER INSTALLATION AND COMMISSIONING SOP

6. SMART METER INSTALLATION AND COMMISSIONING

6.1 INTRODUCTION

This chapter deals with best practices about smart meter installation and should be used in conjunction with OEM and power distribution utility installation standards/specifications and all applicable codes of regulators and CEA. The objectives of this chapter are as follows:

- Safe and reliable standard metering installation, practices that will meet the expectations of customers and stakeholders
- A safe working environment for employees and the public
- Compliance with all statutory regulations

This chapter also outlines general safety and care requirements for smart meters, and testing requirements for smart meters as prescribed by applicable Indian standards.

6.2 LOCATION OF INSTALLATION

The location and size of the smart metering space at a consumer's premises depend on load demand. Generally, for any power distribution utility, consumer premises include:

TABLE 4: TYPICAL LOCATIONS FOR INSTALLATION OF METERS

Society flats	Individual houses/kothies	Government housing flats
Schools/ educational institutions	Commercial complexes	Industrial/factory premises
JJ Colonies/clusters	Hospitals	Public parks
Government buildings	Public toilets	Weekly bazaars
Subways	Footbridges	Temporary connections
Standard PWD lighting poles	Municipal corporation offices	Hotels

6.3 TEST REQUIREMENTS FOR SMART METERS

6.3.1 TYPE TESTS

A series of tests carried out on one meter or a small number of meters of the same type having identical characteristics, selected by the manufacturer to prove conformity with all the requirements of this standard for the relevant class of meter. These are intended to prove the general qualities and design of a given type of meter.

6.3.2 ROUTINE TESTS

Tests were carried out on each meter to check conformity with the requirements of this standard in aspects that are likely to vary during production.

6.3.3 ACCEPTANCE TESTS

Tests were carried out on samples taken from a lot for the purpose of acceptance of the lot.

TABLE 5: SCHEDULE OF TESTS FOR SMART METERS

S. No.	Test name	Type	Routine	Acceptance
1	Test of insulation properties	Yes		
1.1	Impulse voltage test	Yes	Yes	Yes
1.2	AC high voltage test	Yes	Yes	Yes
1.3	Insulationresistance test	Yes		
2	Test of accuracy requirement	Yes		
2.1	Test on limits of error	Yes	Yes	Yes
2.2	Interpretation of test results	Yes		
2.3	Test of meter constant	Yes	Yes	
2.4	Test of starting condition	Yes	Yes	Yes
2.5	Test of no-load condition	Yes	Yes	Yes
2.6	Test of ambient temperature influence	Yes		
2.7	Test of repeatability of error	Yes	Yes	
2.8	Test of influence quantities	Yes		
3	Test of electrical requirement	Yes		
3.1	Test of power consumption test	Yes	Yes	
3.2	Test of influence of supply voltage	Yes		
3.3	Test of influence of short time over currents	Yes		
3.4	Test of influence of self- heating	Yes		
3.5	Test of influence of heating	Yes		
3.6	Test of influence of immunity to earth fault	Yes		
4	Test for electromagnetic compatibility	Yes		
4.1	Radio interference measurement	Yes		
4.2	Fast transient burst test	Yes		
4.3	Test of immunity to electrostatic discharges	Yes		
4.4	Test of immunity to electromagnetic HF field	Yes		
4.5	Surge immunity test	Yes		
5	Test for climatic influences	Yes		
5.1	Dry heat test	Yes		
5.2	Cold test and	Yes		
5.3	Damp heat cyclic test	Yes		
6	Test for mechanical requirements	Yes		
6.1	Vibration test	Yes		

[8] Source - Smart meter standards by Bureau of Indian Standards (BIS): IS13779 (Second Revision)

S. No.	Test name	Type	Routine	Acceptance
6.2	Shock test	Yes		
6.3	Spring hammer test	Yes		
6.4	Protection against penetration of dust and water	Yes		
6.5	Test of resistance to heat and fire	Yes		

6.4 GENERAL SAFETY AND CARE OF SMART METERS

6.4.1 METER BODY

- The meter body should be made of unbreakable, high-grade, fire-retardant, and reinforced insulating material (protective Class II)
- The minimum thickness of the meter enclosure should be 2mm
- The meter base should be opaque and the meter cover should be transparent
- The meter cover and base should use continuous and seamless ultrasonic welding/chemical bonding, so it cannot be opened without breaking the enclosure
- The meter body should be sealed in such a way that opening the meter base and the cover is possible only after breaking the seal(s)
- Unidirectional screws should be used on meter covers, wherever required. However, a single-case meter body is preferable (i.e., the meter top cover and base are a single mold, thus removing the possibility of opening the meter case)

6.4.2 TERMINALS AND TERMINAL BLOCK

- Terminals should be grouped in a terminal block having adequate insulating properties and mechanical strength
- The material of which the terminal block is made should be capable of withstanding a temperature of 135°C and pressure of 1.8 MPa (ISO 75)
- The terminal block should be opaque
- The terminal block, terminal cover, and meter case should be fire-resistant
- The terminal block should have a minimal risk of corrosion, resulting from contact with any other metal parts
- Terminals and connections should be suitable to carry up to 120% of Imax continuously (Imax 60 A)
- Terminals should preferably be of the MS cage clamp type (IS: 15707), or flat end screw with at least 9 mm diameter screws for better contact area
- The internal diameter of the terminal holes should be a minimum of 9.5 mm, and the minimum clearance between adjacent terminals should be 10 mm. The depth of terminal holes should be 25 mm

6.4.3 TERMINAL COVER

- The terminal cover should be short and transparent
- Appropriate space should be available for incoming /outgoing cables, without damaging or stressing terminal cover
- After sealing the cover, a terminal should not be accessible without breaking the seal

6.4.4 SEALING OF SMART METER

- The meter should be reliably sealed to avoid tampering. One polycarbonate seal should be provided by the utility and one polycarbonate seal should be provided by the manufacturer (preferably with the same number as that of a meter). All the seals will be fixed on the meter body by the manufacturer at his works before dispatch
- The meter terminal cover should be sealed
- Seals should be on the front side only; rear-side sealing is not acceptable. Only patented seals should be used, as per CEA Metering Regulations, 2006

FIGURE 11: ILLUSTRATION OF POLYCARBONATE SEAL USED FOR SEALING OF SMART METERS

Source: Tata Power- DDL

6.4.5 DATA DISPLAY FACILITY

- A meter should have two modes of data display: Auto scroll
- Scroll with the push button

6.4.5.1 AUTO SCROLL

TABLE 6: ILLUSTRATIVE PARAMETERS DISPLAYED – AUTO SCROLL

Single-phase	Three-phase
• Display check • Date and time • Last recharge amount • Last recharge time • Current balance amount • Current balance time • Cumulative active energy kWh with legend • Current calendar month MD in kW with legend • Instantaneous voltage • Instantaneous phase current • Instantaneous load kW • Instantaneous average power factor	• Display check • Date and time • Cumulative active energy kWh with legend • Cumulative active energy kVAh with legend • Current month MD in kW with legend • Current month average power factor • Instantaneous voltage VRN • Instantaneous voltage VYN • Instantaneous voltage VBN • Instantaneous current IR • Instantaneous current IY • Instantaneous current IB • Instantaneous current IN • Instantaneous load kW and kVA • Instantaneous average power factor

Source: Tata Power- DDL

The above parameters should be displayed on the LCD/LED continuously for 10 seconds on auto-scroll.

6.4.5.2 SCROLL WITH PUSH-BUTTON

All Parameters mentioned under the auto scroll mode, above, should be displayed, along with the following parameters:

TABLE 7: ILLUSTRATIVE PARAMETERS DISPLAYED – SCROLL WITH PUSH BUTTON

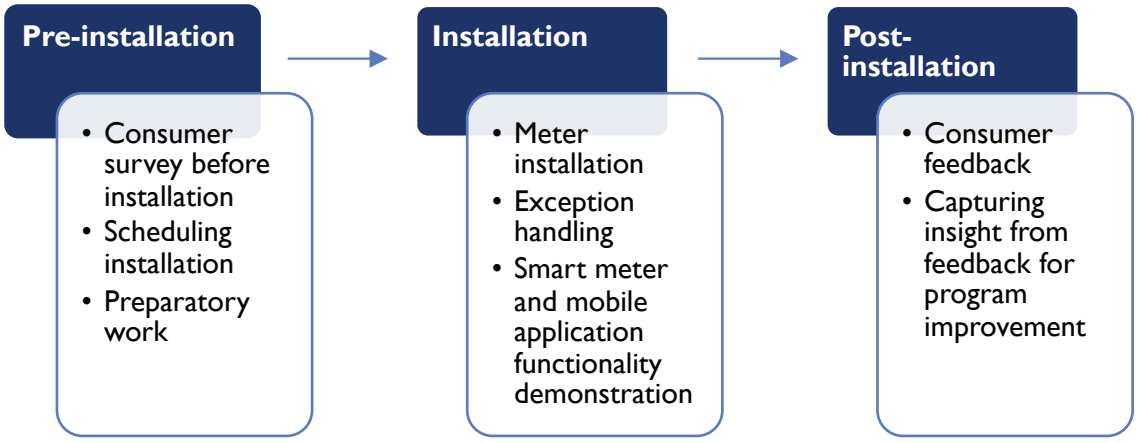
Single-phase	Three-phase
• Internal diagnostics (display check) • Meter serial number • Last month cumulative kWh with legends • Last month MD in kW with legends • Current month average power factor • Last month average power factor	• Internal diagnostics (display check) • Meter serial number • Cumulative energy in kVArh lag/lead with a legend • Cumulative active energy kWh ToD wise with legends • Cumulative active energy kVAh ToD wise with legends • Current month MD in kVAh with legends • Last month cumulative kWh with legends • Last month cumulative kVAh with legends • Last month MD in kW with legends • Last month average power factor

Source: Tata Power- DDL

The meter should display high-resolution energy values, three digits before the decimal and two digits after the decimal, in push-button mode. The meter should return to default display mode (continues auto scroll) if the push button is not operated after 10 seconds. (The order of display may be revised, as per the requirement of the utility). The meter display should not go into sleep mode while powered on.

6.5 SOP FOR INSTALLATION OF SMART METERS

The Standard Operating Procedures (SOPs[9]) detailed in this section provides a structured approach to help utilities engage effectively with consumers during different stages of smart meter deployment. The SOPs cover pre-installation activities, installation, and post-installation activities.

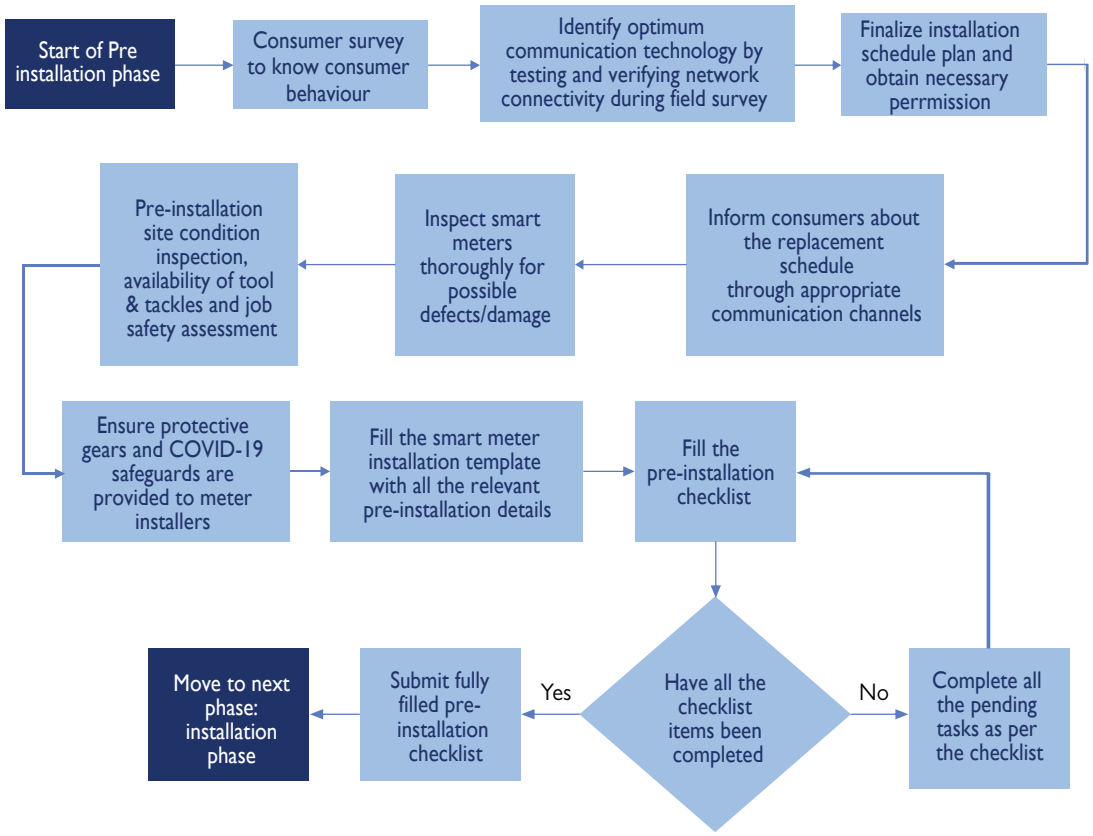


[9] Based on 'Standard Operating Procedures for Installation of Smart Meters' developed by Ministry of Power (MoP), Government of India. Through Smart Power for Advancing Reliability and Connectivity (SPARC) program, USAID/I supported in development of the SOPs. These standard operating procedure is further updated after consultation with utilities - Tata Power-DDL and BSES Rajdhani Power Ltd

6.5.1 WORKFLOW OF ACTIVITIES IN PRE-INSTALLATION PHASE

Before installing the smart meter, it is important to gauge consumer understanding of the technology. The consumer should be informed about the meter-replacement program, and the meter installer should be prepared for rollout. The activities to be performed are summarized in the chart below:

FIGURE 12: FLOW CHART OF PRE-INSTALLATION ACTIVITIES



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6.5.1.1 CONSUMER SURVEYS

A consumer survey should be planned to gain insights into consumer behavior about smart meters. Key activities include:

- Verify network connectivity and optimum communication technology
- The consumer survey should be short, multi-lingual, and allow the rapid collection of informationon the consumer's awareness of smart prepaid metering technology, preferred mode of payment, prepaid metering features and benefits, and consumer concerns regarding various aspects ofsmart prepaid meters (e.g., overbilling, health and safety, prepaid recharges, etc.)
- Address concerns raised by consumers through various communication channels, includingsocial media, YouTube, mass emails, local events, news articles, leaflets, etc.z

This activity will be primarily undertaken by the utility, with necessary support from the meter installer in one-to-one interactions with consumers, as required.

6.5.1.2 PRE-INSTALLATION PREPARATORY WORK – CONSUMER

6.5.1.2.1 Installation schedule

Day-ahead installation schedule is to be prepared for the replacement of smart meters, with locations identified and buffer dates in case of non-accessibility of consumer premises or failure to replace smart meters for valid reasons.

6.5.1.2.2 Pre-Installation communication to consumers

Consumers should be informed about the process and schedule:

- SMS/interactive voice response (IVR) calls/emails about the replacement of conventional meters with smart meters
- Direct door-to-door communication, if virtual notification is not possible
- Consumers should be made to understand that they will not be charged any fee for meter replacement
- Provide multiple time slots options/choices to ensure maximum consumer convenience
- In case installers are unable to contact the consumer, or the consumer is unavailable, provide options for re-scheduling the installation service
- Clearly explain what the installation visit will involve, the need for the consumer to be at the premises, the likely duration of the visit, the need to shut off the electricity supply, and that the smart metering system will be demonstrated, including the prepaid recharge process and the use of mobile applications
- Share contact details regarding the authorized meter installer and date of replacement to the consumer through appropriate communication channels
- Generate report on consumers who have been contacted for pre-installation and the medium of communication

6.5.1.3 PRE-INSTALLATION PREPARATORY WORK – METER INSTALLATION AND LOCATION

6.5.1.3.1 Preparatory work

The following work should be completed before the start of installation

- Obtain necessary approvals/permissions, wherever necessary
- Prepare all required formats for data recording
- Record the type, model, and capacity of the new smart meter, as well as the meter number, seal number, box number, and other details
- Confirm that the communication technology to be used is ready for establishing connection with HES. For instance, for cellular communication based smart meters, meter installers should have activated SIM cards before installation visits

6.5.1.3.2 Meter inspection

- Thoroughly inspect the new smart meter for any possible damages

- Smart meters with broken or damaged seals should be notified and returned to the concerned warehouse manager

- Verify that the manufacturer's seal is intact

6.5.1.3.3 Tools and tackles to be available with the meter installation team

The working team should be equipped with the appropriate tools to install smart meters

FIGURE 13: ILLUSTRATION OF TOOL KIT AND TOOLS

Source: Tata Power- DDL

6.5.1.3.4 Pre-installation site safety inspection and general safety requirements

The site supervisor should check site conditions before starting work as per the job safety analysis (JSA) checklist.

- Ensure availability of necessary tools and equipment
- Check current leakage at consumer and pole end
- Check for proper space and lighting at work site
- Verify smart meter location for the gas/water pipeline near the meter location
- Verify the need for shutdown, if any
- Barricade working and ladder-placement space, as required
- Check for unsafe conditions per JSA checklist, as listed below:

(a) Unsafe conditions at pole

- Pole has 30 or more service cables
- Open joints and jumbling of cables within a 1.5-meter radius
- Physical damage on the pole (cracks, loose installation, bent pole, etc.)
- Two or more feeders (composite networks)
- Bilateral network with LT and HT network on the same pole
- Four or more distribution boxes
- Actions to be taken:
  - Work must be done in presence of the site engineer
  - Check site condition and ask for shutdown, if required
  - Ensure strict use of personal protective equipment (PPE)

- No work should proceed on damaged or cracked poles. The site supervisor/engineer should be informed of necessary action

b) Unsafe conditions at consumer premises

- Water/wet floor near the smart meter site
- Gas/water pipeline near the smart meter location
- The smart meter box is damaged/hanging/tilted on the wall
- No proper continuity of earth at the site (where sanction load is 10 kW or above

General safety requirements

All works should be carried out in compliance with organizational safety requirements as well as Occupational Health & Safety Standards (OHSAS: 18001). Any activity must be stopped if the safety of the workers and general public cannot be ensured. Safety practices at the site must include:

- Use of PPE, including safety helmet with visor, safety shoes, hand gloves, full-body harness with double rope latching arrangement including thigh protection, etc.
- No work under the influence of drugs or alcohol
- No smoking or chewing tobacco
- No bamboo scaffolding
- A first-aid box should be available, and installers should be trained in basic safety

FIGURE 14: ILLUSTRATION OF TECHNICIAN IN PPE KIT

Source: Tata Power- DDL

6.5.1.4 PRE-INSTALLATION CHECKLIST AND INSTALLATION TEMPLATE

6.5.1.4.1 Smart metering installation template

- A standard meter-installation template should be prepared, and relevant pre-installation data to be pre-filled before installation
- The installation template should be available in two copies (either physical or digital format) of which one copy to be shared with the consumer and one retained by the meter installer

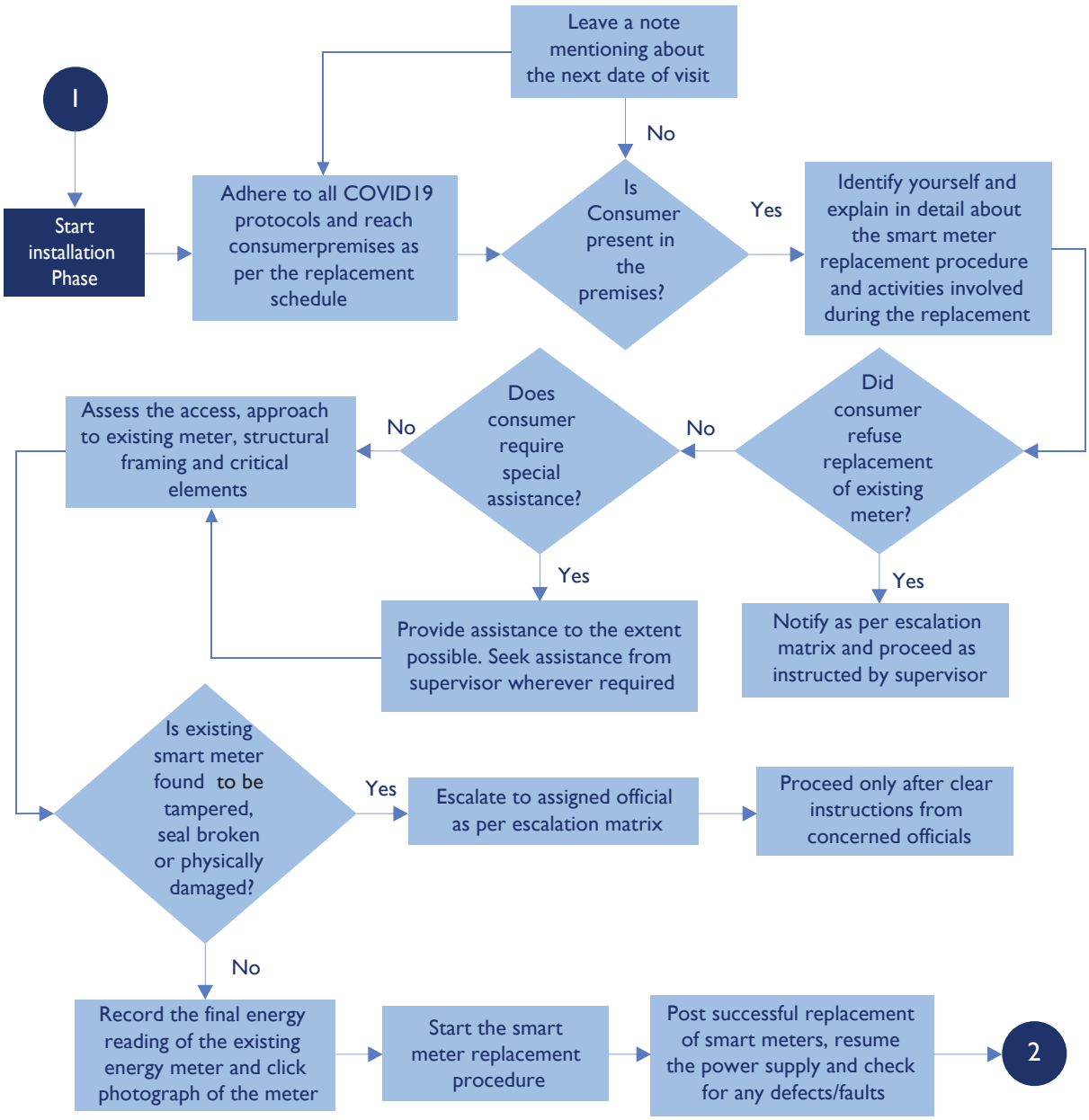
- The sample meter-installation template is provided in **Annexure-II: Sample meter installation template**

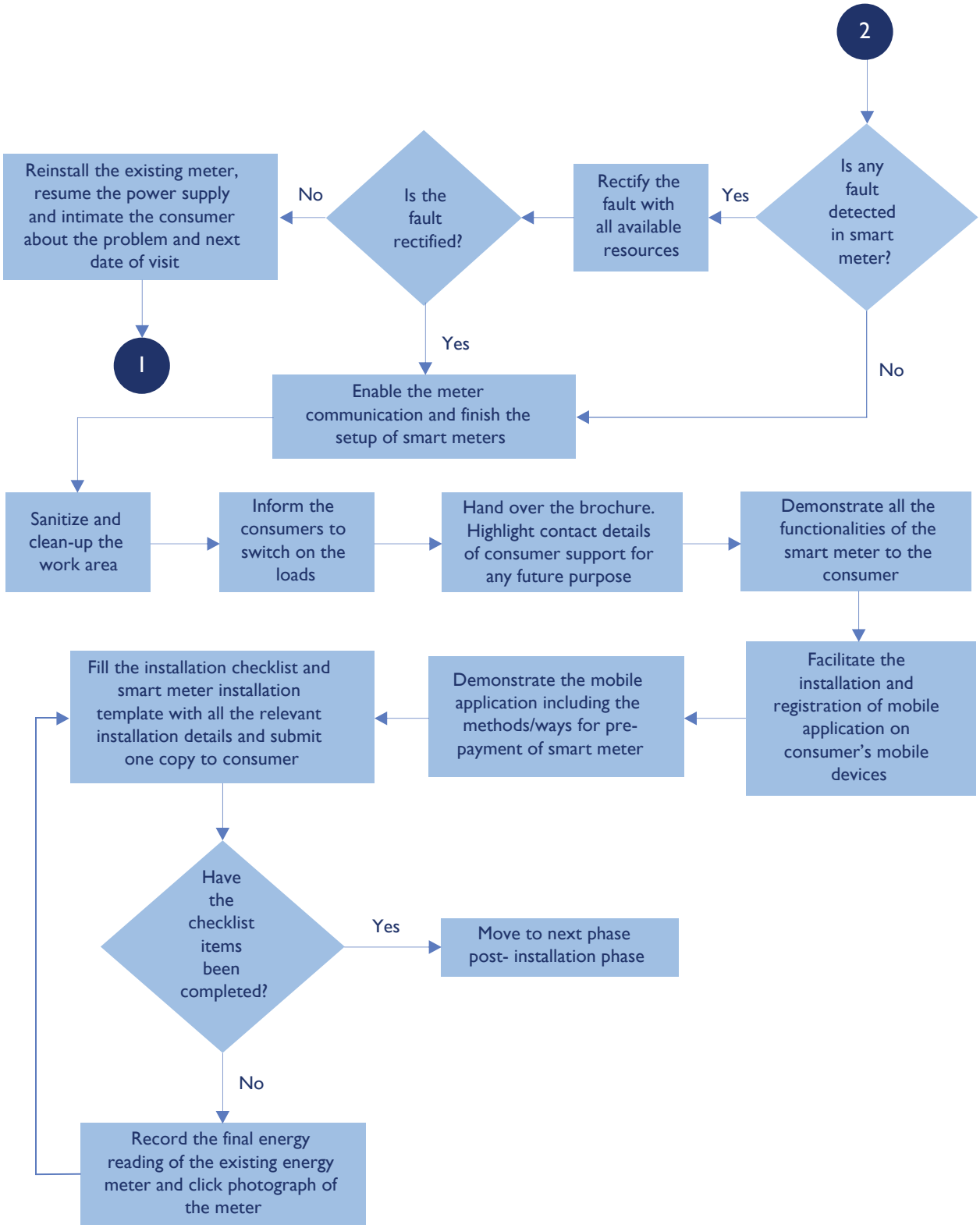
6.5.1.4.2 Pre-installation checklist

- The completed pre-installation checklist should be submitted before the start of installation
- The checklist records all activities performed during pre-installation and ensures adherence to pre-installation SOPs
- A sample pre-installation checklist is provided in **Annexure-III: Sample pre-installation checklist**

6.5.2 WORKFLOW OF ACTIVITIES IN INSTALLATION PHASE

FIGURE 15: FLOWCHART OF ACTIVITIES IN THE INSTALLATION PHASE





Source: Based on 'Standard Operating Procedures for Installation of Smart Meters' developed by Ministry of Power (MoP), Government of India. Through Smart Power for Advancing Reliability and Connectivity (SPARC) program, USAID/I supported in development of the SOPs. The standard operating procedure is further updated after consultation with utilities - Tata Power-DDL and BSES Rajdhani Power Ltd

6.5.2.1 INSTALLATION

6.5.2.1.1 General guidelines for smart meter installation

- Meter installer should carry out the replacement work only when consumer is present in the premise
- The smart meter should be installed near the entrance or outer wall, to be easily accessible for installations, testing, commissioning, reading, recording, and maintenance
- The meter should be protected from excessive dust and moisture, direct sunlight, rain, water seepage, and vermin. The site temperature should be between 0°C and 50°C. The meter should not be close to machinery, heating devices, equipment generating strong vibrations, magnetic fields, or areas prone to fire or toxic hazards
- The meter should not be in an elevated or depressed area that cannot be accessed through a stairway
- The height of the meter display should be between 750 mm and 1800 mm. This also applies if the meter has a secondary display unit
- Maintain a minimum clearance of 50 mm around the smart meter, for better inspection. The space between two-meter boxes should be at least 300 mm
- All installation work should take place under the supervision of a power distribution utility engineer or supervisor
- Use MCB/MCCB/ELCB having an ISI/BIS mark and of the proper size/rating
    - o For single-phase, connections, use two-pole MCB/ELCB
    - o For three-phase connections, use four-pole ELCB/MCCB
- Ensure that ELCB (if the load is 2 kW or more) is installed
- Ensure that the smart meter is located before the main switch
- Ensure a proper earthing connection extending up to the smart meter box. For three-phase meters, the consumer's earthing should be connected with the meter box earthing
- Ensure that meter box has a clear and legible earth symbol at each earthing connection point
- To avoid tampering and misuse by consumers:
    - o The service line should be visually traceable and joint-free
    - o Seals should be visible and accessible for easy inspection
- The earthing connection should not be used as a return conductor and should not carry a neutral current
- The smart meter should always be installed with the smart meter box
- The smart meter box should be properly fixed to the wall using metallic fasteners
- Service cables/wires should enter the smart meter box through the gland
- The earthing/armor wires of the service cable should be properly dressed and connected to the box earthing with a jubilee clamp/tightening clamp

- Aluminum lugs/thimbles must be properly crimped using the appropriate crimping tool.
- The upper screws in each terminal should be tightened first, followed by lower screws
- When installing smart meters at premises below HT/EHV lines, a technical feasibility clearance must be obtained in advance
- In case of HT connections, ensure earthing of the smart metering cubicle and smart meter box Earth test results should be recorded on the protocol sheet
- During installation and post-installation, ensure that all cables and wires are insulated and adequately protected against electrical, mechanical, chemical, or other injuries

6.5.2.1.2 Start of meter replacement

A. Adherence to COVID-19 protocols and other guidelines

- Meter installers should adhere to all current COVID-19 protocols, including:
  - Wear a mask at all times
  - Check body temperature before field deployment
  - Thoroughly disinfect tools and equipment before reaching consumer premises
  - Sanitize all surfaces after installation

B. Identification

Meter installers should identify themselves with an identity card displaying their name, company details, contact number, and photograph, and present the information brochure (if made available by the utility) on smart meters. Key points to be communicated to consumers include:

- Procedure of replacement
- Loss of power during installation, and expected duration of a power outage
- All the functions of the smart meter, in a clear and accurate manner
- The need to assess approach and access to the existing electrical meter, structural framing system, and critical elements that may need attention before meter replacement

C. Consumer refusal

- If the consumer refuses to allow the installation of the smart meter: Provide resolutions, to the extent possible
- Record the reasons for the refusal and escalate to the liaison officer (as per the escalation matrix) and await further instructions before proceeding

D. Special assistance

- Check whether the consumer requires any special assistance or other special considerations
  - Physical handicaps, old age, etc.
  - Use of medical devices, so power cuts may not be feasible
- Make the best possible effort to accommodate reasonable requests
- Inform supervisor and seek guidance when necessary

E. Damaged meters

- If the existing meter has been tampered with, its seal is broken, it is burnt or physically damaged, etc., take photographs of the abnormal conditions to inform the supervisor
- Record this information in the installation template
- Replacement should only proceed after approval from the appropriate authority

F. Meter reading

- Capture a clear photograph of the existing meter, with the final reading, in the presence of the consumer before shutting down the power supply
- Details of the meter-installation template (as provided in **Annexure-II: Sample meter installation template**) should be filled out, including meter reading, maximum demand, meter number, box number, seal number, etc.

G. Meter replacement procedure

Distribution/Busbar box installations

Install the distribution box/busbar box according to the availability of space and number of connections. The distribution box is available in the following sizes:

- Single-phase two-wire, four ways (1 I/C + 3O/G) – approx. size. 350mm x 270mm x 160mm
- Three-phase seven-ways (1 I/C + 6 O/G) – approx. size 400mm x 300mm x 200mm
- Three-phase 10-ways (1 I/C +9 O/G) – approx. size 500mm x 400mm x 200mm

Other elements to be considered include:

i. **Mounting of distribution box -** must be mounted in a straight position using metallic fasteners

ii. **Mounting height -** boxes should be mounted in an accessible position at least 300mm above ground and up to a normal human height

iii. **Use of lugs (thimbles) –** use lugs of the appropriate size, per the wire to be connected in case of a strip-type busbar box. In the case of an Allen-key base busbar, there is no need for lugs or thimbles

iv. **Dressing of incoming (I/C) and outgoing (O/G) cables -** all I/C and O/G wires should be properly placed inside the box to avoid jumbling

v. **Glands of I/C & O/G -** the appropriate-size gland must be used for all I/C and O/G wires

vi. **Vermin proofing -** all holes must be filled with M-seal/equivalent sealant to prevent the entry of vermin

vii. **Sealing the box –** the distribution box should be properly sealed

viii. **Load balancing (for three-phase meters) –** ensure that the load is balanced for all three-phases

ix. **Nuts and bolts in strip-**type busbar boxes, and screws in Allen-key type busbar boxes, should be properly tightened to avoid loose connections

x. **Earthing marking -** ensure that marking is present on all distribution boxes and busbar box earth terminals

Each box should be provided with earthing from the main incoming cable and all outgoing cable earthing should be connected to the provided earthing terminal.

STEPS FOR METER BOX INSTALLATION

- Make a marking on the wall for the smart meter box with a leveling frame (height from three to six feet)
- Drill a hole in the wall
- Accurately position the smart meter box
- Affix the smart meter box and tighten the screws

STEPS FOR METER FIXING IN METER BOX

- Mount the meter in the center of the smart meter box, using the mounting screw
- Affix the smart meter with screws
- Unscrew all the smart meter terminals
- Insert the service line in the smart meter terminals, in sequence

FIGURE 16: ILLUSTRATION OF DISTRIBUTION BOX

Source: Tata Power- DDL

WORK INSTRUCTIONS FOR SINGLE-PHASE METER AND THREE-PHASEMETERREPLACEMENT WITH SMART SINGLE-PHASE METER AND SMART THREE-PHASE METER

- Only an authorized lineman is permitted to work on a live network to replace a meter
- All live line activity should be done under the supervision of the engineer in-charge
- The lineman should wear PPE (gloves, safety shoes, helmet with visor) and lay an insulated rubber mat on the ground where the work is executed

- Note the last reading of a single-phase meter on the service order. For a three-phase meter, also note the ToD reading
- Disconnect the load by switching off (MCB/ELCB/RCCB/MCCB on the consumer end)
- Confirm the existence of an inverter/generator or any other source of supply, to avoid the chance of reverse/back current. If possible, disconnect the identified source from the main line or disconnect the neutral physically until meter replacement work is complete
- Open the meter box with a seal cutter
- Capture the existing meter box seal numbers on the service order
- Open the terminal cover with the appropriate size screwdriver

STEP TO BE FOLLOWED FOR REPLACEMENT OF OLD SINGLE-PHASE METER AND OLD THREE-PHASE METER

Single-phase meter replacement steps

- Unscrew and remove terminals of phase input and put an insulated cap on the bare part
- Unscrew and remove terminals of neutral input and put an insulated cap on the bare part
- Unscrew and remove terminals of neutral output and put an insulated cap on the bare part
- Unscrew and remove terminals of phase output and put an insulated cap on the bare part

Remove the existing meter, and replace it with the smart meter, checking the new meter's physical condition by sequentially removing the insulating caps:

- Remove taping, insert the wire in the terminal of phase output and screw the terminal properly
- Remove taping, insert the wire in the terminal of neutral output and screw the terminal properly
- Remove taping, insert the wire in the terminal of neutral input and screw the terminal properly
- Remove taping, insert the wire in the terminal of phase input and screw the terminal properly

Three-phase meter replacement steps

- Unscrew and remove the incoming phase and neutral wires in sequence R-phase, Y-phase, B-phase, and the neutral wire. Tape all the uninsulated parts of the removed cables properly to avoid shorting. Marking should be done with red, yellow, blue, and black tape
- Unscrew and remove the output phase and neutral wires in sequence R-phase, Y-phase, B-phase, and the neutral wire. Tape all the uninsulated parts of the removed cables properly to avoid shorting. Marking should be done with red, yellow, blue, and black tape
- Replace the old meter with the new one. Place the new meter on the box mounting screw and tighten both lower screws along with the meter box mountt
- Remove tape, insert the output cable in terminals and screw them in sequence: neutral, B- phase, Y-phase, and R-phase wires
- Remove tape, insert the wires, and screw the input cable in neutral, B- phase, Y-phase, and R-phase wires
- Connect the earthing with earth point at the meter box with a jubilee clip through armoured for the cable size (4×25 sq. mm, 4×50 sq. mm) in the three-phase meter

- Check continuity of earthing at the metering end with a double test lamp, after the meter is energized

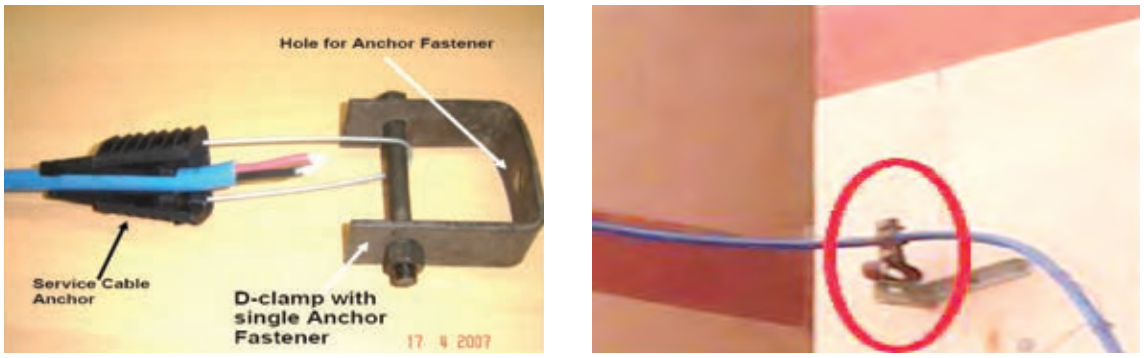
Installation of service cable

Laying of service cables from the nearest LT pole/LT service pillar/DT (HVDS) can be done either overhead (O/H) or underground (U/G), depending on site conditions.

6.5.2.1.2.1 Connection on Pole and consumer wall

- The service cable should be tightly placed and clamped at the pole end using slotted angles/ D clamp, etc., to hold in place during the laying of service lines
- The service cable should be supported using a service cable anchored to the angle bracket/D-clamp/wall-corner clamp

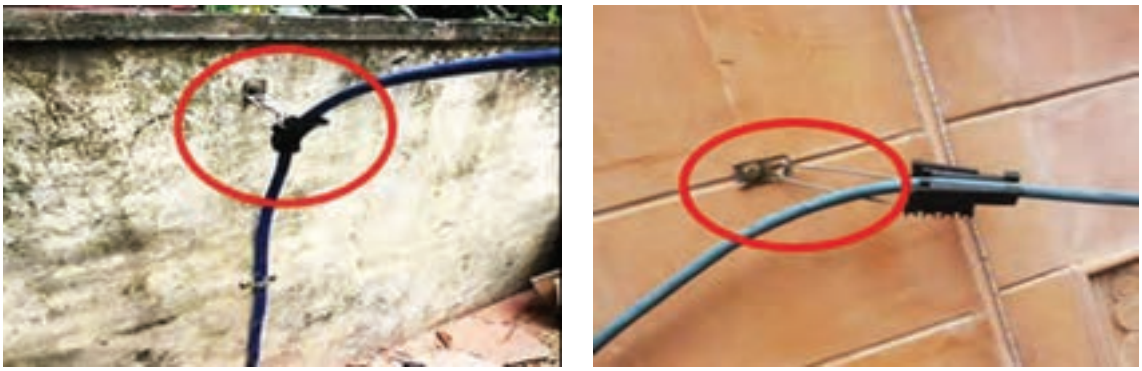
FIGURE 17: D-CLAMP AND SERVICE CABLE ANCHOR GI CONNECTOR



Source: Tata Power- DDL

- Three-phase cables should be supported with a GI connector of appropriate size (35×6 for 4C×25 /4C×50 sq. mm cable and 50×6 for 4C×95 / 4C×150 / 4C×300 sq. mm cable) or pin insulator (medium size)
- The service cable on the consumer wall should be supported with a wall-corner clamp, angle bracket, service main suspension clamp, or anchor clamp, as per site conditions

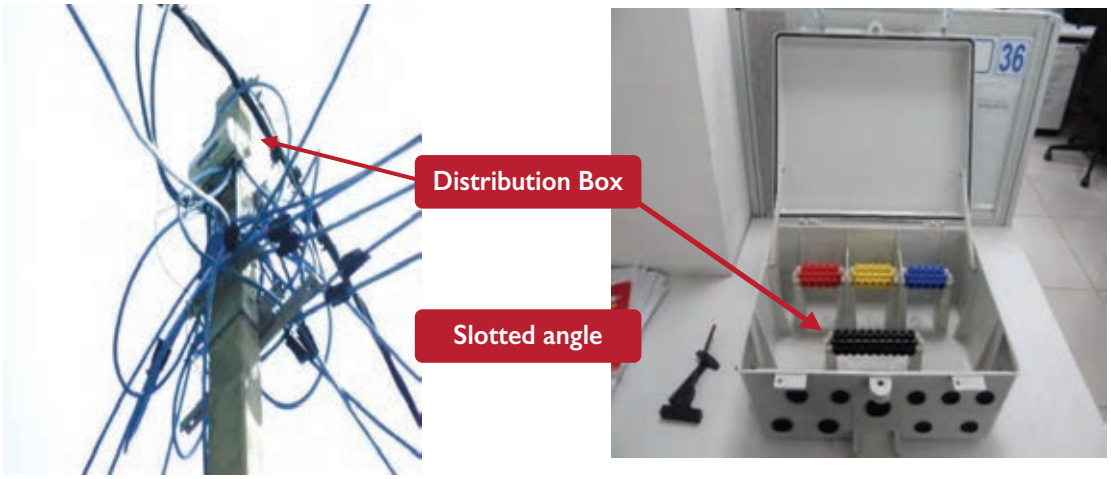
FIGURE 18: D-WALL CORNER CLAMP AND SERVICE MAIN SUSPENSION/ANCHOR CLAMP



Source: Tata Power- DDL

- The height of the service cable crossing the road must be at least 5.8 meters above ground level
- The height of the service cable along the road must be at least 5.5 meters above ground level. Elsewhere it must be at least 4.6 meters (bare conductor) and 4.0 meters (insulated conductor/ service cable)
- A binding wire (dog/rabbit conductor) should be used to tie up all the three-phases and neutral on the D-hook for the O/H LT line, instead of service cable phases (do not use armored wire cables)
- For the existing LT ABC line, the service line connections must be executed with proper-sized IP connectors
- The service cable armoring should be connected to the earth conductor of O/H LT and LT-ABC. For LT ABC (an old type with five wires), the service able armor should be connected to the messenger wire through the distribution box

FIGURE 19: CONNECTIONS FROM LT-ABC USING DISTRIBUTION BOX



Source: Tata Power- DDL

6.5.2.1.2.2 Connections from Service Pillar

- The cable should be laid underground and enter into the pillar-box from the bottom portion
- Avoid sharp bending of the service cable while entering the service pillar
- The service cable should not be laid from the front/back side of the feeder/service pillar so that the front/back door can be closed and locked properly. The service cable must be laid through the entry hole beneath the feeder/service pillar
- Use aluminum lugs/thimbles of the appropriate size for service cable termination leaving the cut-out in the service pillar

The service cable should be properly earthed at the feeder/service pillar to the earthing busbar using a jubilee clamp/earth gland and properly sized thimble Safety and quality aspects to be considered during meter installation:

- While connecting the smart meter tighten the lower terminal screw first after inserting the service cable in the meter terminal. The upper terminal screw should be tightened after the lower terminal screw
- The service cable conductor should not touch the gland

- Avoid sharp bends while laying the service line (bend should not be more than 12 degrees)
- Fill the remaining air gap of the gland with M-seal compound
- Connect the meter output wire with consumer-provided ELCB/MCB/MCCB near the meter box (MCB – up to 2 kW, ELCB - more than 2 kW)
- After energizing the smart meter, the engineer in charge/supervisor should check the display andother parameters (as mentioned in Table 6: and Table 7:)
- Check the earthing with a double test lamp by connecting one wire with the earth point (nut) and connecting a second wire with the phase of ELCB/MCCB/MCB (ensure that ELCB/ MCCB/MCB are off during testing)
- The engineer in charge should check the meter accuracy with a standard Accu-check device and record the results in the service order
- Seal the smart meter with polycarbonate seals and cut any extra seal wires
- Sealing arrangement for single-phase smart meter: one seal at the smart meter terminal and four seals at the smart meter box
- Sealing arrangement for three-phase smart meter: two seals at the smart meter terminal and four seals at the smart meter box
- Complete the details in the service order after all technical work
- Describe the display parameters of the new meter and tariff details to the consumer
- Check the meter and network interface card (NIC) communication signal
- Obtain the signature of the consumer on the meter installation service order. Give the consumer a copy of the service order, along with the meter test notice, safety pamphlet, etc.
- Obtain feedback from the consumer
- Before leaving the site, collect and remove cable/PVC scrap and dispose of it in a proper location

6.5.2.2 ACTIVITIES POST INSTALLATION OF SMART METERS

- Turn on the power supply after completion of the installation
- Test the meter for any operational defects
- After successful communication and functional testing, seal the terminal cover of the meter or meter box, and record the seal number in the smart meter installation template
- Clean up and sanitize the work area

6.5.2.2.1 Handling faults

In case faults are observed after resuming the power supply,

- If a fault is identified in the smart meter after replacement, try to rectify the fault on site
- Make the consumer aware of the problem, the likely resolution, and the approximate timeline
- In case of non-resolution of faults, reinstall the old meter and inform the consumer about the next appointment for replacement
- Share contact details with the consumer, if they need to access any further information

6.5.2.2.2 Failing to finish setup

If the meter installer fails to finish work due for any reason,

- Inform the consumer about the reason and provide the timeline for the next visit

- Re-install the old meter and resume the power supply

6.5.2.2.3 Brochure and query resolution

- Explain the consumer welcome brochure (if made available by the utility) like the key content, and contact details for questions and feedback post smart meter installation
- Make the best effort to resolve all consumer queries on-site
- All unanswered queries related to smart meter functionality, cybersecurity, and data privacy should be escalated per the defined escalation matrices

6.5.2.2.4 Explanation of prepayment method

- In case of prepayment connection, inform the consumer about the prepayment mechanism, including information about the various modes of recharge (online and offline)
- Inform the consumer about the process for checking account balances and accessing low-balance notifications
- Inform the consumer about disconnection protocols

6.5.2.2.5 Installation of mobile application

Facilitate the installation of the mobile application on the consumer's smartphone and demonstrate all the relevant functionalities

6.5.2.2.6 Meter installation template

Put all relevant information in the meter-installation template. One copy of the completed meter- installation template should be given to the consumer (in physical or digital form)

6.5.2.2.7 Installation checklist

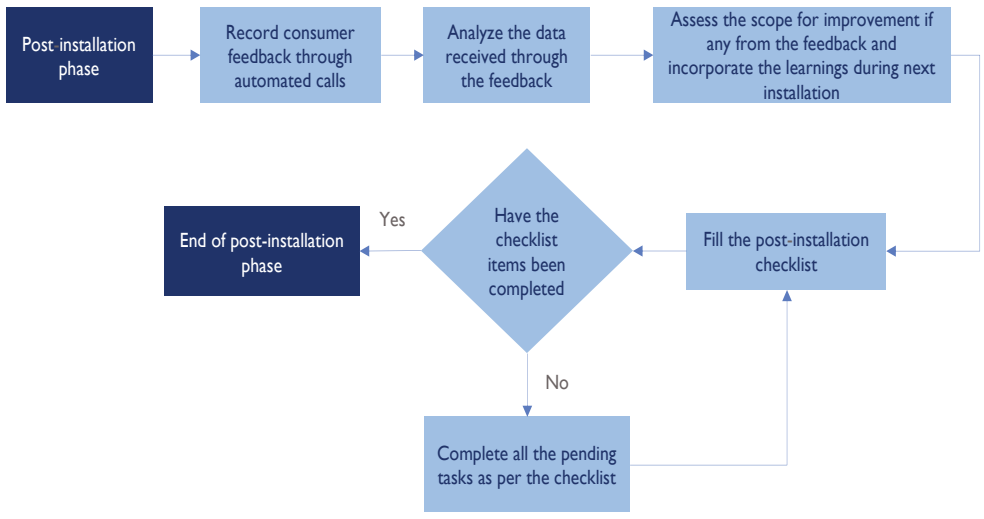
The installation checklist should be completed once all installation activities are done. The meter installer should complete all pending tasks as highlighted in the checklist. A sample meter-installation checklist is provided in **Annexure-IV: Sample Installation Checklist**

6.5.3 WORKFLOW OF ACTIVITIES IN THE POST-INSTALLATION PHASE

To ensure the successful rollout of smart meters, an adequate focus on consumer engagement is crucial immediately after meter installation. At this stage, meter installers should seek overall feedback to improve the rollout program.

Before starting the activities detailed in this phase, meter installers should complete the detailed checklist provided during the installation phase and submit this to the utility and the consumer.

FIGURE 20: FLOW CHART OF POST-INSTALLATION ACTIVITIES



Source: Based on 'Standard Operating Procedures for Installation of Smart Meters' developed by Ministry of Power (MoP), Government of India. Through Smart Power for Advancing Reliability and Connectivity (SPARC) program, USAID/I supported in development of the SOPs. This standard operating procedure is further updated after consultation with utilities - Tata Power-DDL and BSES Rajdhani Power Ltd

6.5.4 SEEKING CONSUMER FEEDBACK

Meter installers should prepare a set of questions for consumers, which will help assess consumer satisfaction levels and areas for improvement. The survey can cover:

- Effectiveness of utility consumer engagement: feedback on whether consumers received a brochure, information was clear, information was made available through different media, etc
- Assessment of overall consumer experience throughout the smart meter installation process
- Whether meter installers demonstrated smart metering technology (including the prepaid recharge process and use of the mobile application) and resolved consumer concerns/queries in a courteous manner
- Whether the relevant consumer information captured in the meter installation template was verified and validated by the consumer

The survey can also capture consumer concerns/comments on the replacement procedure, usage of smart meters, mobile applications, billing, recharging, etc

The survey can be performed via different media (personal interaction with consumers automated feedback calls, emails, SMS, consumer portal of the utility, etc.), However, several aspects to be considered while preparing the consumer survey strategy.

- **Recording consumer feedback:** Automated calls should be made to consumers about filling out the questionnaire, and feedback should be collated and used to improve the installation process continually
- **Number of questions:** Utilities should limit data collection to the extent consistent with the results required, the consumer's relationship with the business, or as required or specifically authorized by law
- **Language:** A choice of language (including local languages) should be provided to consumers responding to the questionnaire
- **Continuing analysis:** Consumer feedback should be analyzed to continuously enhance the smart meter deployment program. These insights can improve the smart metering program and increase consumer participation in other areas of utility operation
- The post-installation checklist should be completed and submitted once all post-installation activities are done. Any pending tasks identified in the checklist should be completed. A sample post-installation checklist is included in **Annexure-V: Sample Post-Installation Checklist**

7. OPERATION AND MAINTENANCE

Once the smart meter has been installed at the consumer premises, the meter should not require regular maintenance unless there are complaints from the consumer, or the utility observes discrepancies in meter reading or irregularities in the consumption.

Some common issues of smart meters include:

- In-house display not working
- Meter display not working
- Incorrect meter recording or meter not functioning
- Meter not communicating data back to control system

7.1 COMMON STEPS TO BE FOLLOWED BY METER TECHNICIAN

Action will be initiated by the technician based on the complaint lodged by the consumer with consumer care. Key steps include:

- Tell the consumer the schedule for the next site visit
- In case the consumer is unavailable on the scheduled date/time, provide an alternate date/ time to the extent feasible
- Confirm the visit with messages to the consumer, including details about the technician visiting the premises
- Once at the premises, provide identification documents to the consumer
- Adhere to the COVID-19 protocols (discussed in chapter 4) while visiting consumer premises
- Attend to the complaint and, at the end of the visit, brief the consumer about the work done and the way forward
- If there are still issues, escalate to supervisor for further guidance
- Complete the visit report in the presence of the consumer and obtain a signature. One copy of the report should be given to the consumer, and the second deposited in the report office of the technician
- Communicate with the consumer after completion of the visit through email/SMS/other means

7.2 IN-HOUSE DISPLAY NOT WORKING

Check the device:

- No display or blank display
    - o If the display is blank, confirm that power supply is available, or battery is charged
    - o If supply is available/battery is charged, take the device for inspection at the utility repair center/authorized repair center
    - o If the equipment is covered by warranty, replace it with a new meter
    - o If repair is not possible, replace the faulty device with a new device, based on utility policy
    - o A temporary replacement can be provided to the consumer depending on utility practice

- Message on display – “Waiting for data” or “Connection lost”

  o Check the distance of display from the meter

  o Is the meter separated from the display by thick walls?

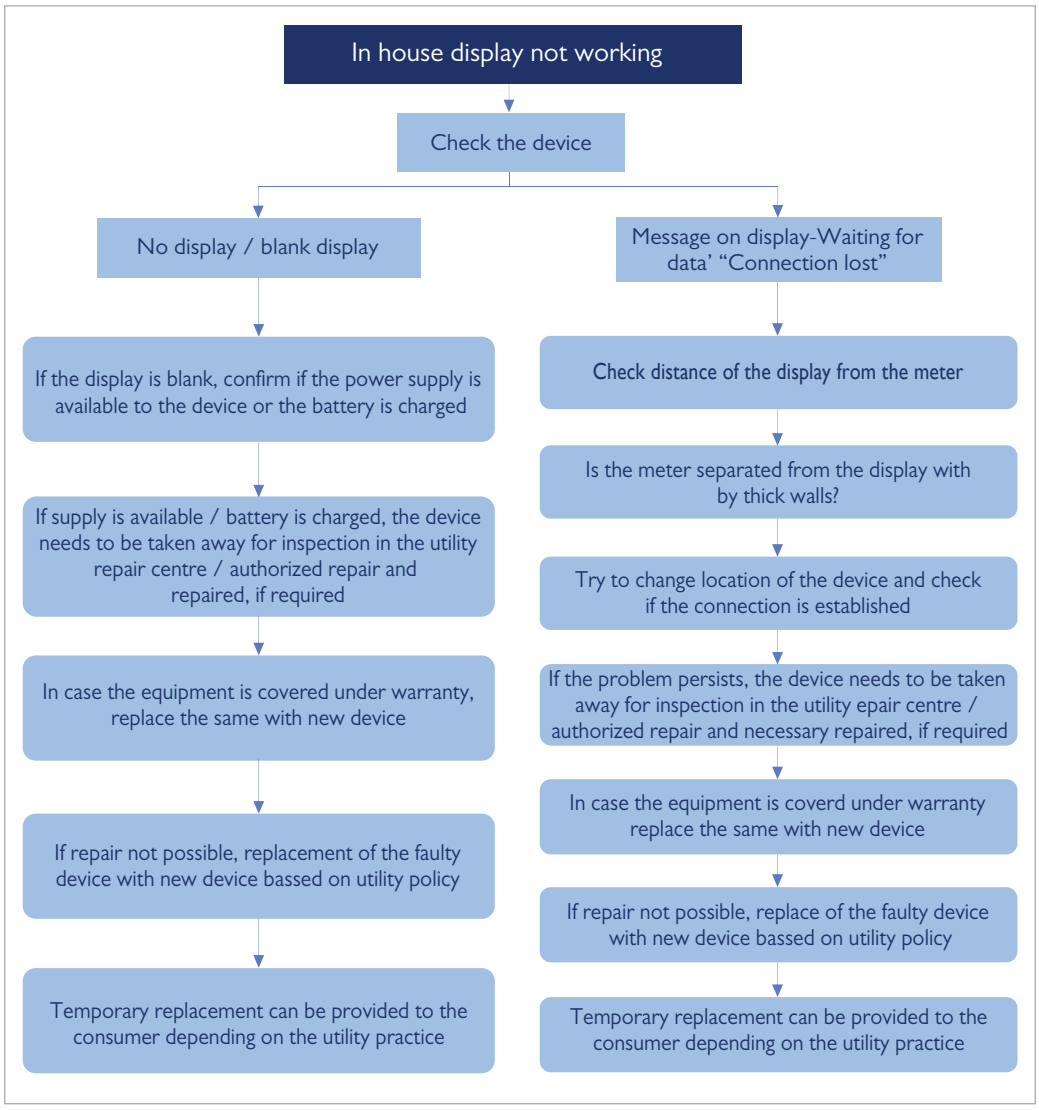
  o Try to change the location of the device and see if the connection is established

  o If the problem persists, the device needs to be taken for inspection in the concerned ware house

  o If immediate repair is not possible, replace the faulty device with a new device, based on utility policy

- Convey to the consumer that a faulty display will not impact the functioning of the meter and energy consumption will be recorded properly

FIGURE 21: STEPS FOR ADDRESSING “IN-HOUSE DISPLAY NOT WORKING”

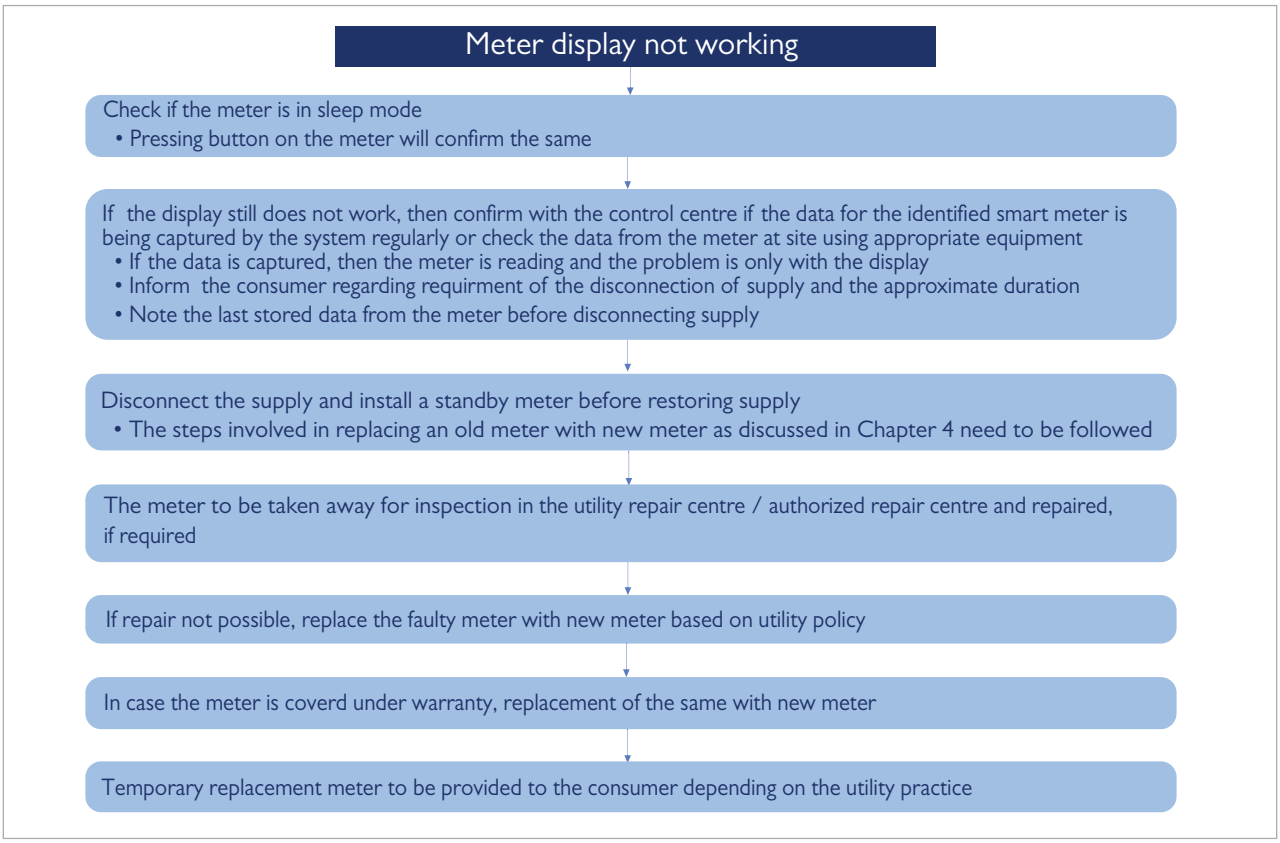


7.3 METER DISPLAY NOT WORKING

- Check the meter: no display or blank display

- Check if the meter is in sleep mode by pressing the button
- If the display still does not work, confirm with the control center whether the data is being captured by the system, or check data from the meter on-site using the appropriate equipment
- If data is being captured, the meter is reading, and the problem is only with the display
- Inform the consumer about the need and duration of disconnection of supply
- Record the last stored data from the meter before disconnecting the supply
- Disconnect the supply and install a standby meter before restoring the supply. Follow the steps outlined in chapter 4
- Take the meter for inspection to supervisor or concerned warehouse manager
- If immediate repair is not possible, replace the faulty meter with a new meter, based on utility policy

FIGURE 22: STEPS FOR ADDRESSING "METER DISPLAY NOT WORKING"

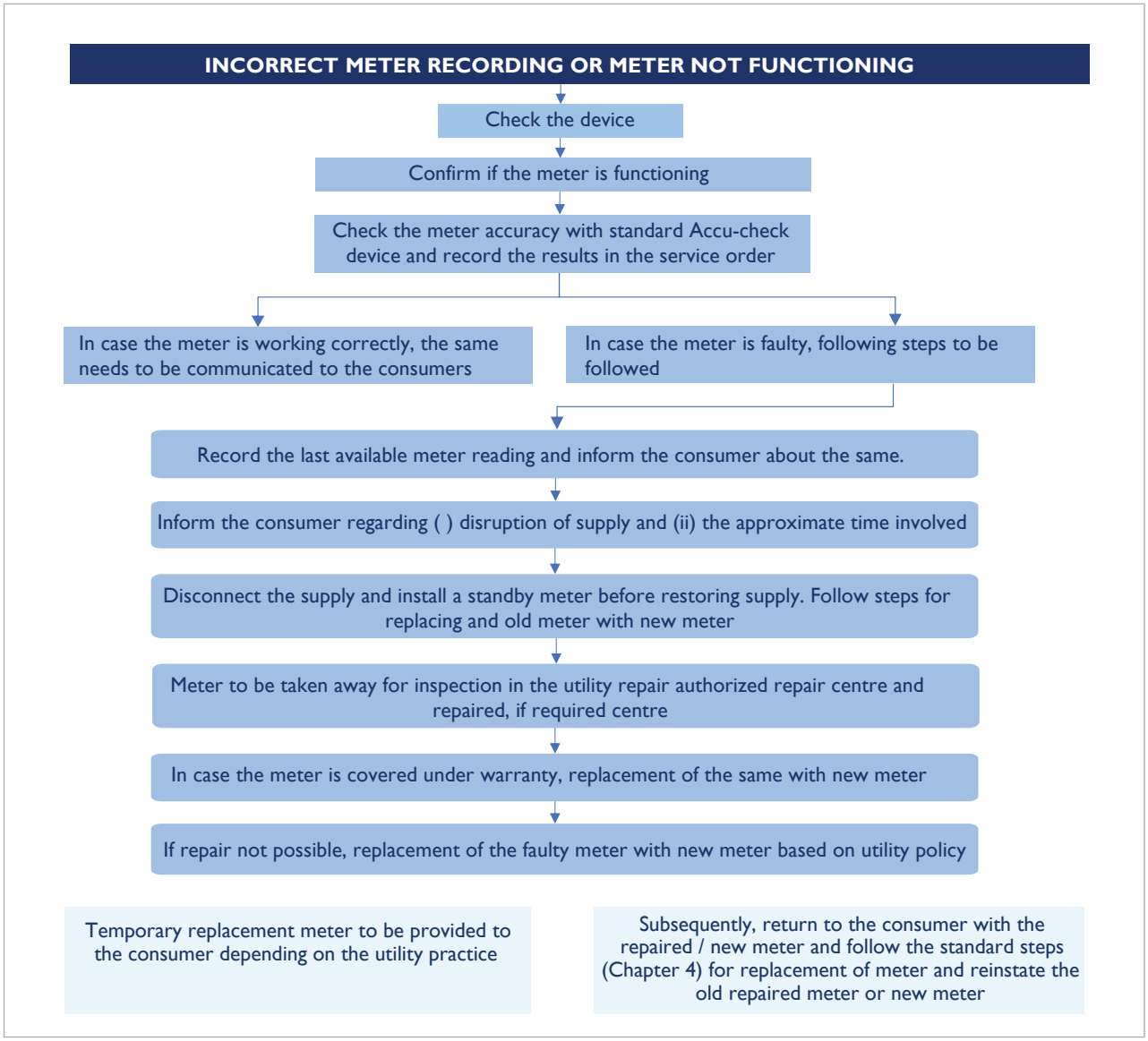


7.4 INCORRECT METER RECORDING OR METER NOT FUNCTIONING

- Confirm whether if the meter is functioning
- Check meter accuracy with standard Accu-check device and record results in the service order
- If the meter is working correctly, communicate this to the consumer

- If the meter is faulty:
  - o Note the last available meter reading and inform the consumer
  - o Tell the consumer how long supply will be disrupted
  - o Disconnect the supply and install a standby meter before restoring the supply
  - o Take the meter for inspection to supervisor or concerned warehouse manager
  - o If immediate repair is not possible, replace the faulty meter with a new meter, based on utility policy

FIGURE 23: STEPS FOR ADDRESSING "INCORRECT METER RECORDING OR METER NOT FUNCTIONING"

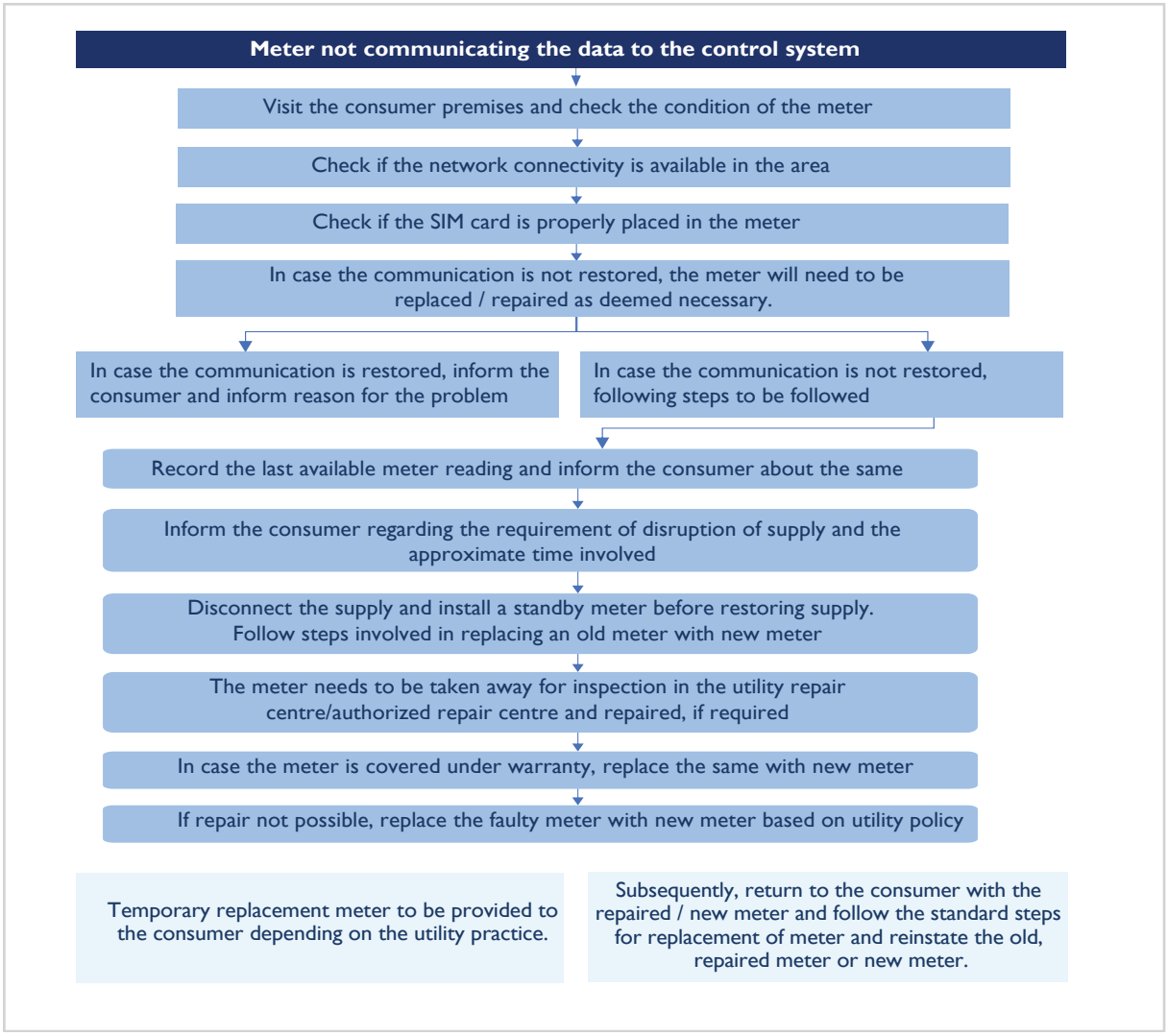


7.5 METER NOT COMMUNICATING DATA BACK TO CONTROL SYSTEM

- Visit the consumer premises and check the condition of the meter
- Check if network connectivity is available in the area

- Check if the SIM card is properly placed in the meter
- In case communication is not restored, the meter will need to be replaced or repaired as deemed necessary
- Steps to be followed:
  - o Note the last available meter reading and inform the consumer
  - o Tell the consumer how long supply will be disrupted
  - o Disconnect the supply and install a standby meter before restoring the supply
  - o Take the meter for inspection to supervisor or concerned warehouse manager
  - o If immediate repair is not possible, replace the faulty meter with a new meter, based on utility policy

FIGURE 24: STEPS FOR ADDRESSING "METER NOT COMMUNICATING THE DATA TO THE CONTROL SYSTEM"



PART III

CONSUMER ENGAGEMENT

8. CONSUMER ENGAGEMENT

8.1 WHY IS CONSUMER ENGAGEMENT CRUCIAL?

The success of smart meters rests on consumer engagement and willingness to adopt new technologies. Since smart meters allow consumers to monitor consumption and billing, Discoms must encourage consumer participation. Resistance to smart meters has been noted even in some developed countries due to consumer ignorance. Clear messaging is a prerequisite for customer engagement and the smooth rollout of smart meters. The soft skills required for effective and successful consumer engagement is about learning a set of behaviors and relationship-building skills that put the consumers first and identifies the service provider as a trusted entity, not as just another supplier.

8.2 CONSUMER ENGAGEMENT BY METER INSTALLERS

The meter installer/technician is the utility consumer's first point of contact. The utility should, therefore, understand the skill sets of its technicians, including:

- Whether the meter installer understands the technology
- Whether the installer can lucidly demonstrate smart meter use
- Awareness of public etiquette and gender sensitivity
- Fluent in the consumer's language

8.2.1 DIRECT CONSUMER ENGAGEMENT

The first point of contact in direct consumer engagement is the meter installer, who physically visits the consumer's premises and represents the utility. Post-installation services, such as addressing complaints, customer care service, mobile apps, and SMS alerts, and gathering feedback are other points of direct engagement that define the consumer's experience with the utility

Meter installation

1) Prepare the consumer for the first visit

The meter installers/technician should

- Call the customer in advance and set a convenient time to visit and install the meter
- Explain the benefits of smart meters
- Assure the consumer that there are no hidden costs involved
- Arrive on time and promptly display an identity card
- Carry an information brochure to share with the consumer
- Be polite and patient, as the consumer may have doubts about the technology
- Demonstrate the smart meter to the consumer, including a first reading
- Rectify any faults on site
- Clean up and sanitize the area of work
- Alert the consumer to customer-care numbers on the brochure, and encourage them to

download the utility's mobile app before leaving

- Set time for a second visit and resume power supply through the old meter, in case work cannot be finished

2) Prepare the meter installer/technician for consumer interaction

- Before installing smart metering systems, the installer should be trained by the utility
- IInstallers should know how to address customer queries and/or refer them to the appropriate contacts
- Installers must be trained to adhere to safety protocols

Post-Installation activities: Here are some mechanisms that can make consumers feel more connected to the Discoms:

- Complaint-redressal mechanism: A prompt system to resolve consumer complaints and concerns should be instituted via a digital app and customer-care executives The Discom should establish a help desk that consumer can visit in-person
- Frequently asked questions (FAQs): Consumers should be directed to standardized digital and physical FAQ brochures, which address anticipated concerns and provide help desk contacts
- Mapping customer feedback: To monitor smart meter performance and improve service, consumer feedback should be obtained at regular intervals. This could be done through phone calls, email prompts, digital apps, or door-to-door visits
- Disconnection protocols: The customer receives phone, email, and SMS notifications alerting them well in advance about low balances or pending disconnection. A payment-alert system will ensure that consumers are not left stranded without power
- Discom social-media channels: Discoms should have active social media accounts to monitor customer feedback and complaints
- Share success stories: To inspire confidence in customers, Discoms should socialize success stories highlighting the benefits of smart meters to consumers
- Consumer perks: Incentives such as discounts, rewards, contests, and recognition as "ideal customers" will positively encourage consumers

3) Break gender stereotypes to improve consumer buy-in

- Training and deploying women for consumer engagement can be beneficial where (especially when most house visits are made during the day when typically, men are out of house engaged in livelihood activities and) women are present at home.
- The heightened sense of safety in a scenario where a female installer is explaining/introducing the concept to women present in the house may lead to a correlated trust level. Additionally, gender sensitivity and some soft skills would come naturally to a female technician especially when communicating to female residents/consumers.

4) Employing women to conduct soft skill training particularly for male technicians/installers

To make male technicians aware or conscious of certain soft skill engagement techniques when interacting with female consumers; training conducted by women can support topics like:

- Listening and communication, attentiveness, managing difficult conversations etc.
- Respectfulness, personal space, and etiquette

PART IV
ANNEXURES

9. ANNEXURES

9.1 ANNEXURE-I: ILLUSTRATIVE JOB SAFETY ANALYSIS (JSA)[10]

(Name of the Distribution utility) – (Job Safety Analysis) (JSA format)		
Meter Management Group (MMG) JSA checklist for single/three-phase		
_____ Sub-division code :	Date:	Notification/ Request Number_____; CA Number_____
Engineer: Identification ID Number Band/ Eligibility: Agency Name: Vehicle Registration: _____ Team Leader: _____ Supervisor Identification ID Number_____ Band/Eligibility: Lineman Identification ID Number _____ Band/Eligibility: Helper Identification ID Number_____ Band/Eligibility: Meter installer Identification ID Number_____ Band/Eligibility: The time when work has started: Time when work has ended:		1) Sub-division Contact information: 2) Safety control office contact number: _____, +91 - _____ 3) In the sub-division where the work is in progress, write the contact number and name of another team engineer starting from the nearest: 4) Telephone number of the nearest Civil Hospital _____ 5) List of other hospitals is present nearby:
Work is being done under the supervision of a permanent engineer. Live line work is done under the supervision of the operation engineer (whose ID card no. is of ----Series) .		
Important checks before starting work:		
After reaching the work site kindly ensure:	Yes	No
Are the hand gloves, face shield/visor, double line yard full-body harness available for the linemen?		
Before starting the work, was it made sure that the linemen do not have any accessories like a chain, bracelet, etc. worn by him and the team mobile handsets are given to the driver or have been placed in a locked box in the van?		
Is the lighting sufficient on-site to work safely?		
Does the consumer wall have any other utility service (water pipe, electricity wires, or gas pipeline) present in the wall?		
Does the site have earthing?		
Is the wall capable of sustaining the weight of the meter, meter box, and the weight of the cables?		
While installing a new meter/ meter box/ bus box sufficient height, 3-6 feet can be maintained?		
Is an ISI marked MCB/ELCB/RCCB/RCD installed by the consumer for cutting the load on-site?		

[10] Source- Tata Power DDL

(Name of the Distribution utility) – (Job Safety Analysis) (JSA format)				
Meter Management Group (MMG) JSA checklist for single/three-phase				
Part-I **Identification of dangers while standing on the ground**				
Choose the method of connection (1) Pole (1.a) Bare (1.b) LTABC (2) Feeder pillar/Service pillar (3) Ground busbar				
	Kindly write the details such as pole number, feeder pillar/service pillar number			
I	Have the following situations been checked before starting the work on the pole?	Yes	No	If yes, then write the steps that were taken after suggestions from the hand engineer or team leader to make the workplace safer –
	1) Is there leakage current on the pole?			
	2) Does the pole have 2 or more LT feeders available, coming from different transformers? If yes, then please specify the count.			
	3) Does the pole have more than 4 LT-ABC feeders or 2 ABC and 1 or more than one bare network connection present?			
	4) Is there a network of 30 or more service wires present on the pole?			
	5) Is there any cable within 5 feet radius of the pole with damaged insulation or does the LT-ABC network or rising cable has damaged insulation? If yes, please tell the count.			
	6) Does the pole have more than 2 networkss (HT/LT) -composite network? If yes, so please specify the count			
	7) Does the pole have any external cable or wire (Cable T.V., internet)?			
	8) Is there pole encroachment due to unauthorized construction?			
	9) Is the pole broken/ tilted or cracked?			
	10) Are there more than 4 distribution boxes present on a single pole?			
	11) Does the last pole, T-off pole, or the pole at the turn does not have a stay wire or Stud pole available?			If yes, then before starting the work give the pole enough support (using at least 2 bamboo ladders) or make sure to use the tower wagon before continuing the work
	12) Is the physical condition of the ladder suitable for work and does it have any crack, stiffness, or twisting?			If yes, please don't use that ladder
	13) Before starting the work was it ensured that the height of the ladder is sufficient, and the ladder can be properly placed at a ¼ distance from the pole?			If not, please ask for the ladder of appropriate height from the back office/ zone and place the ladder correctly and then only start the work
	14) Has the ladder in use has been properly checked and does it have the serial number, given by the agency?			If not, please refrain from using that ladder
	15) Before placing the ladder, was the work site checked for possible situations such as uneven surface or, oily, slippery or loose surface, etc. and has it been found safe for work?			If not, please inform your engineer/ back office. If required, get extra manpower/ helper to give support to the ladder to make the worksite safe and then only start the work
	16) Before starting the work, has it been ensured thatthere is sufficiently barricading around the worksite?			If no, then remove any obstruction in the way of barricading and only after putting appropriate barricading, start the work

(Name of the Distribution utility) – (Job Safety Analysis) (JSA format)				
Meter Management Group (MMG) JSA checklist for single/three-phase				
	17) In case of a shutdown: has the switch for streetlights been switched off by the sub-division during work hours?			If not, then start your work only after the switch for the streetlight has been turned off
	After evaluation of the situation, it has been determined that the work can be done without a shutdown			If not, then proceed with the work only after shutdown. And in serial number 7 describe LT PTW and LOTO. Even in the case of a shutdown, please ensure that you are using all required PPEs like hand gloves, face shield visor, etc.
Part-2 Identification of dangers related to network after climbing the pole (before starting the work) (After climbing the pole, the lineman should assess the dangers present there for at least 2 to 3 minutes)				
2	Danger identified by the lineman. The description is as follows	Yes	No	If the answer to questions 1-6 is Yes", then write down the steps that were taken after suggestions from the engineer/team leader to make the worksite safe
	1) Is there any wire or LT-ABC network with damaged insulation inside the worksite of the lineman, if yes, so write the count			
	2) Is the current leakage in any part of the pole?			
	3) Is there a crack in the upper part of the pole?			
	4) Does the distribution box (both outgoing and incoming) or the single-phase DT have wires with damaged insulation or cut thimbles?			
	5) Is there current present in the non-insulated wire?			
	6) Does the pole have a streetlight switch, connected wires, or damaged insulation?			
	7) After climbing the pole and evaluating the situation, has it been determined that the work can be done without a shutdown			If no, then only proceed with the work after shutdown. And describe LT PTW and LOTO (Lock Out Tag Out) in serial number 7. Even in case of a shutdown, ensure the use of all required PPEs like hand gloves, face shield visor, etc.
3	If you are in the primary tagging list then before taking shutdown through GO (Gang Operated) switch, kindly take the below-written precautions			
	1) Before operating the GO switch has it been ensured that the load on the LT switch has been switched off creating a no-load condition?			
	Do the GO handle or the 3-phase blades have any kind of damage or any other operating problem?			
	3) After operating the GO handle has it been ensured that there is a proper separation between the blades of the three-phases?			
	4) Is an electrical safety zone created after taking all the steps of a safety zone?			
4	To work on old/present bus box/distribution box/service pillar/ feeder pillar, cable removal, temporary meter:	While opening the cover of the meter box, make sure to be on the side and also use the necessary PPEs like gloves, helmet with visor, and insulating rubber mat while opening it.		
	1) Does the bus box or distribution box or service pillar/ feeder pillar have any leakage current?			Write down the steps that were taken after suggestions from the engineer /team leader to make the worksite safe
	2) Are there damaged/ burnt part/ cut off thimbles, loose nut bolts present. If yes, please specify the count			
	3) Are there any naked wires/ loose joints in the bus box / distribution box / service pillar/ feeder pillar?			

(Name of the Distribution utility) – (Job Safety Analysis) (JSA format)				
Meter Management Group (MMG) JSA checklist for single/three-phase				
	4) Is the situation of vermin proofing of the gland bad?			
	5) Does the bus box or distribution box or service pillar or feeder pillar have doors hanging from broken hinges or the box doesn't have a cover?			
	6) Have all the surrounding unsafe situations been analyzed and is the worksite safe to work?			If no, then only proceed with the work after shutdown. And describe LT PTW and LOTO in serial number 7. Even in case of a shutdown, ensure the use of all required PPEs like hand gloves, face shield visor, etc.
5	If the meter has to be replaced			
	1) Did a visual inspection happen and was the condition of the service cable and meter terminal checked?			
	2) Is there any leakage current present in the meter body/ nearby circuit?			
	3) Is the review for all types of naked wire/ loose joints done and is there a need to insulate them? If yes, then please specify the count			
	4) Are there any other points to be inspected such as burnt meter terminal, swinging meter, the meter in a burnt state, or broken seal on the meter and is there a requirement of fixing them on-site?			
	5) Is there an ISI marked MCB/MCCB/ELCB/RCD present to cut the meter's load?			
6	Mention any other dangers found other than the above-mentioned points and also write the methods adopted to deal with them			
7	7 If after analyzing questions 1-6 you find out that the work cannot be done without shutdown then after switching off the LT instrument, following the LT PTW procedure make sure to use LT LOTO LT PTW No.= LOTO No.-			If no, then do not start work without making an appropriate safety zone.
Part-3 After completion of work				
8	After completion of work did the lineman rectify the unsafe situations like damaged insulation or service cables joined without insulation which is situated on the pole or busbar box or distribution box or service box or feeder pillar. If yes, please specify the count			If not, then please inform the supervisor and make sure to create an entry on the safety portal Safety ID number: _____
	Is the wiring and phase sequence correctly colorcoded? (If this is not found on-site, then please do the correct color coding)			
Signature Engineer: Supervisor Lineman		Helper Meter Installer		

9.2 ANNEXURE-II: SAMPLE METER INSTALLATION TEMPLATE[11]

<DISCOM NAME AND ADDRESS> SMART METER REPLACEMENT PROGRAM (Following details to be captured during installation of a smart meter)				
	Parameter	**Observation**	**Remarks**	**Data capturing method**
1	Consumer details			
1.1	Service request number	X1234567	Service request number generated for replacement of smart meter	Prefilled
1.2	Customer ID number	12345678910111120	Consumer connection details to be captured and verified with details provided by Discom	To be filled before installation
1.3	Customer service number	N1234567		
1.4	Consumer name	Mr. XYZ		
1.5	Consumer address	Flat-XYZ, sector ABCD,		
1.6	Address pin code	New Delhi-1100xx		
1.7	Consumer contact details	9988xxxxxx		
1.8	Consumer category	LT 1 – Domestic	Details of consumer category as per the tariff order for the state	
1.9	Phase	3phase/1phase		
1.10	Sanctioned load	2 kW	Consumer connection details to be captured and verified with details provided by Discom	
1.11	Connection status	Active/ disconnected/ temporary connection etc.		
1.12	Purpose of meter replacement	Smart meter installation	Reason for meter replacement	Prefilled

[11] Source: Based on 'Standard Operating Procedures for Installation of Smart Meters' developed by Ministry of Power (MoP), Government of India. Through Smart Power for Advancing Reliability and Connectivity (SPARC) program, USAID/I supported in development of the SOPs. These standard operating procedure is further updated after consultation with utilities - Tata Power-DDL and BSES Rajdhani Power Ltd

<DISCOM NAME AND ADDRESS> SMART METER REPLACEMENT PROGRAM (Following details to be captured during installation of a smart meter)				
S. No.	**Parameter**	**Observation**	**Remarks**	**Data capturing method**
1.13	Date of smart prepaid meter installation	x/xx/xxx	Date of installation of smart meter	To be filled at consumer premise
1.14	Any other details		Any other details observed during the Installation visit	
2	Area information			
2.1	Section code/ Sub-division code	456	Details of the location to be captured by area code	To be filled before installation
3	GIS information			
3.1	Latitude meter	xxxxx° N	Details of latitude and longitude to be captured for Geotagging of smart meter	To be filled at consumer premises
3.2	Longitudem eter	xxxxx° E		
4	Network information			
4.1	HT line code (Feeder)	Z1678	Details of the connection	To be filled before installation
4.2	DTR code(s)	Z2678	In the case of the ring system, all DTRs connected to consumers are to be recorded. To be verified with details provided by Discom	
4.3	LT line code (Pole)	X1678	Details of the connection	
5	Existing meter			
5.1	Meter serial number	12345678	The unique serial ID of the existing meter	To be filled at consumer premises
5.2	Meter seal number	ABCD123	Unique meter seal number of the existing meter	
5.3	Meter box number	XYZ123	Unique meter box number of the existing meter	
5.4	Reading (as on date of installation)	25876 units	Important billing information. should be supported by meter's data download/ picture of meter reading at the time of replacement	

<DISCOM NAME AND ADDRESS> SMART METER REPLACEMENT PROGRAM (Following details to be captured during installation of a smart meter)				
S. No.	**Parameter**	**Observation**	**Remarks**	**Data capturing method**
5.5	Maximum demand Reading	1.8 kW	Reading present in existing meter	
5.6	Existing meter type	Single/Three-phase digital/ Electro mechanical	Details of the existing meter type	
5.7	Meter make	XYZ	Details of the existing meter make	
5.8	Meter category	Whole current/CT operated	Details of the existing meter category	
5.9	Energy recording type	Unidirectional/ Bidirectional	Details of the recording type of existing meter	
5.10	Meter condition	Working/tampered/ burnt	Condition of existing meter. Should be supported by a picture of the meter, taken at the time of installation	
5.11	Meter seal condition	Intact/tampered/ damaged	Condition of the existing meter seal. Should be supported by a picture of the seal, taken at the time of installation	
5.12	Meter box condition	Intact/ Tampered/ Damaged	Condition of the existing meter box. Should be supported by a picture of the box, taken at the time of installation	
5.13	Old meter removal status (removed/ retained)	Removed	To be filled after installation of new meter	
5.14	Other remarks		Any other remarks observed during installation visit	
6	New smart meter details			
6.1	Smart meter serial number	87654321	Unique ID of new meter	To be filled at consumer premises
6.2	Seal number	DFGH123	Unique ID of seal number	

<DISCOM NAME AND ADDRESS> SMART METER REPLACEMENT PROGRAM (Following details to be captured during installation of a smart meter)				
S. No.	**Parameter**	**Observation**	**Remarks**	**Data capturing method**
6.3	Box number	A987	Unique ID of box number	To be filled at consumer premise
6.4	Meter make and model number	ABCD- Model Number 3287	Meter information viz. model and make	
6.5	Meter communication (GPRS/ PLC/ RF etc.)	GPRS	Mode of communication of the new meter	
6.6	Meter category	Whole current/CT operated	Details of the new meter	
6.7	Energy recording type	Unidirectional/ Bidirectional		
6.8	New meter type	Single/Three-phase	Details of the new meter type	
6.9	SIM card provider	XYZ	Details of the network service provider. Applicable only in case of cellular communication	
6.10	Meter capacity	5-30A, 2 Wire, 240V, 50Hz, 3200imp/kWh	Meter information	
6.11	Signal strength for meter communication	Good	To be checked post-installation of smart meter	
6.12	New meter functioning	All functionalities tested okay	Specific observations should be highlighted here	
6.13	Other remarks		Any other remarks observed post smart meter installation	
7	Consumer demonstration			
7.1	Meter functioning demonstrated to the consumer (Y/N)?	Yes	Newly installed smart meter to be demonstrated in detail to consumers	To be filled at consumer premises
7.2	Awareness material shared	Yes	Share the brochure and information booklet with the consumers	

<DISCOM NAME AND ADDRESS> SMART METER REPLACEMENT PROGRAM (Following details to be captured during installation of a smart meter)				
S. No.	**Parameter**	**Observation**	**Remarks**	**Data capturing method**
	with the customer			
8	Mobile application demonstration			
8.1	Application downloaded	Yes	Facilitate the installation of mobile applications on consumer smartphone	To be filled at consumer premise
8.2	Application registration	Complete	Facilitate the registration of downloaded mobile applications on consumer smartphone	
8.3	Application feature demonstration (Y/N/NA)	Yes	Demonstration of mobile application demonstration. To be mentioned as NA if no mobile application is available for demonstration	
9	Additional remarks			
9.1	Additional remarks	Additional remarks from the installation personnel	Any specific point to be noted about the installation/ about the consumer/ about the location/ about the old meter / about the new smart prepaid meter etc.	To be filled at consumer premise
10	Utility representative information			
10.1	Service personnel name	Mr. ABCD	Name of the installation personnel to be recorded	
10.2	Employee ID/ contractor ID	123456	Unique ID of the installation personnel- to be assigned by the Discom	To be filled at consumer premise

9.3 ANNEXURE-III: SAMPLE PRE-INSTALLATION CHECKLIST[12]

(To be filled before the commencement of smart meter replacement activities)

S. No.	Description	Response
1	Service request number	_____
2	Has the consumer been surveyed during consumer indexing and consumer survey?	Yes / No
3	Has the site supervisor checked the site condition before starting work?	Yes / No
4	Have the required approvals/permissions been taken?	Yes / No
5	Have the installation schedule and contact details of the meter installers been communicated to the consumer?	Yes / No
6	If the answer to Q2 is yes, then what was the communication channel (s)? (Tick all that applies, Tick Not Applicable if noschedule has been shared)	Not Applicable / SMS / E-Mail / IVR Call / Door-to Door communication
7	Has the consumer been notified that no fee is applicable for the meter replacement?	Yes / No
8	Is the smart meter installation template prepared and relevant information pre-filled as mentioned in the template?	Yes / No
9	Have all items like enclosure, meter, meter seals, accessories, etc. been made available with the installation team?	Yes / No / Partially available
10	Has the smart meter been inspected for possible damages?	Yes / No
11	Have the meter installers been handed proper safety equipment including requirements under COVID-19 protocol?	Yes / No
12	Has liaison officer been identified for handling escalations, exceptions, and challenges	Yes / No
13	In case of Installation of cellular communication-based smart meters, have SIM cards been activated?	Yes / No
14	Service personnel name	_____
15	Employee ID/Contractor ID	_____

[12] Source: Based on 'Standard Operating Procedures for Installation of Smart Meters' developed by Ministry of Power (MoP), Government of India. Through Smart Power for Advancing Reliability and Connectivity (SPARC) program, USAID/I supported in development of the SOPs. These standard operating procedure is further updated after consultation with utilities - Tata Power-DDL and BSES Rajdhani Power Ltd

9.4 ANNEXURE-IV: SAMPLE INSTALLATION CHECKLIST[13]

(To be filled after smart meter installation completion)

S. No.	Description	Response
1	Service request number	_____
2	Were all the COVID-19 protocols followed?	Yes / No
3	Was arrival at the consumer's premises timely?	Yes / No
4	Was installation carried out in presence of the consumer?	Yes / No
5	Was consumer explained about the detailed procedure for smart meter replacement and informed about the interruption of power during the replacement?	Yes / No
6	Did the customer refuse a replacement of the existing meter?	Yes / No
6a	If the answer to Q-6 was yes, was the issue escalated to the supervisor?	Yes / No
7	Did the consumer require any special assistance (due to old age/ medical condition/ disability etc.)?	Yes / No
7a	If the answer to Q-7 was yes, was the necessary assistance provided?	Yes / No / NA (no special assistance needed)
8	Was the existing meter damaged/ tampered with?	Yes / No
8a	If the answer to Q-8 was yes, was the issue escalated to the assignment official?	Yes / No
9	Was installation completed before sunset?	Yes / No
10	Was the meter tested to be functional and communication successful?	Yes / No
10a	If the answer to Q-10 was no, was the existing meter reinstalled, and was the consumer given the next date of visit?	Yes / No

[13] Source: Based on 'Standard Operating Procedures for Installation of Smart Meters' developed by Ministry of Power (MoP), Government of India. Through Smart Power for Advancing Reliability and Connectivity (SPARC) program, USAID/I supported in development of the SOPs. These standard operating procedure is further updated after consultation with utilities - Tata Power-DDL and BSES Rajdhani Power Ltd

S. No.	Description	Response
11	Has the power supply been resumed?	Yes / No
12	Has the meter been sealed?	Yes / No
13	Has the brochure been shared with the consumer and all aspects explained (including the process of prepaid recharge)?	Yes / No
14	Has the mobile application been downloaded by the user?	Yes / No
15	Was the prepayment method explained?	Yes / No
16	Has the smart meter installation template been filled and a copy shared with the consumer?	Yes / No
17	Has the area been sanitized and cleaned before leaving the premises?	Yes / No
18	Service personnel name	_____
19	Employee ID/contractor ID	_____

9.5 ANNEXURE-V: SAMPLE POST-INSTALLATION CHECKLIST[14]

(To be filled after demonstration and feedback completion)

S. No.	Description	Response
1	Service request number	_____
2	Has the consumer been contacted through automated calls for feedback?	Yes / No
3	Has the result of the consumer feedback been analyzed?	Yes / No
4	Have the insights from the consumer survey been shared with relevant teams to support program improvement	Yes / No
5	Assessment personnel name	_____
6	Employee ID/Contractor ID	_____

[14] Source: Based on 'Standard Operating Procedures for Installation of Smart Meters' developed by Ministry of Power (MoP), Government of India. Through Smart Power for Advancing Reliability and Connectivity (SPARC) program, USAID/I supported in development of the SOPs. These standard operating procedure is further updated after consultation with utilities - Tata Power-DDL and BSES Rajdhani Power Ltd

ABOUT SAREP

The South Asia Regional Energy Partnership (SAREP) is the flagship regional energy program of the United States Agency for International Development (USAID) mission to India (USAID/I). This five-year initiative (2021-26) will improve access to affordable, secure, reliable, and sustainable energy in six countries — Bangladesh, Bhutan, India, Maldives, Nepal, and Sri Lanka — in line with these countries' climate and clean energy priorities.

The program is a key activity under the U.S. Government's Asia Enhancing Development and Growth through Energy (EDGE) initiative and aligns with USAID's climate change priorities to advance equitable and ambitious actions to confront the climate crisis. The program helps the U.S. Government's Indo-Pacific Vision and facilitates collaboration among the six countries in South Asia to accelerate the transition to clean energy, mitigate climate change, and promote energy security.

SAREP will enable modernization of transmission, system operation, and distribution utilities in the region to improve their technical, financial, and operational performance, grid resilience, enhance customer service, and promote adaptability to new technical advancements. The expected outcome is modern and financially viable utilities that enable clean energy transition and efficient energy markets.

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