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A Survey of Monitoring and Controlling Power Theft Problem in Local Area

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Abstract: *The paper discuss the distribution structure of talapara bilaspur chattisgarh and how the power theft problem in this area is monitored and controlled. Almost about 7000 houses are located and power theft problem is very popular in this area. Illegal consumption of electricity or electricity theft constitutes a major share of NTL (Non-Technical Losses). This dissertation discusses several methods implemented by illegal consumers for stealing electricity. comprehensive review of the advantages, challenges and technologies involved in the design, development, and deployment of smart meters is presented and distribution wire of aluminium is replaced by rubber coating and insulating wire. Illegal consumer used non-linear load like cooking heater, water heater, freeze, washing machine, tube light, exhaust fan, CFL etc. The theft of power overloads the distribution system and causes low voltage, voltage dips problem and generate heavy harmonics in power system.*

Keywords: *Electrical Theft, Power Theft*

INTRODUCTION

The Generation, Transmission and Distribution (T&D) of electricity involve huge operational losses. In order to identify illegal consumers of electricity in the view of enhancing the economy of utilities, efficiency and security of the grid, a new method of analysing electricity consumption patterns of customers and identifying illegal consumers is proposed and realized. Consumer of these area in about 30% is not educated and theft of electricity by old method (generally used hooking) and about 20-25% consumer are legal but they used other illegal connection of electricity and cause non-technical losses. In these area 1500 meter are connected by local substation, 30-35% illegal connection and 25-30% used both hooking and metering methodology. Some other local mechanic and shopkeepers like welder, broiler shops, laundry shop, winder, carpenter are using illegal connection by distribution lines but all the distribution line of aluminium is replaced by rubber coating wires so these connections are decreases and other technique of illegal connection is used like pole hooking by the help of electricians is used. Various methods are adopted to prevent the line theft problem in the distribution line such as rubber coated wire. Figure 1 represents the rubber coated wire and figure 2 represents the uncoated distribution line. Power theft by hooking can be seen in the uncoated distribution line as shown.



Fig. 1 Distribution Line With Rubber Coating

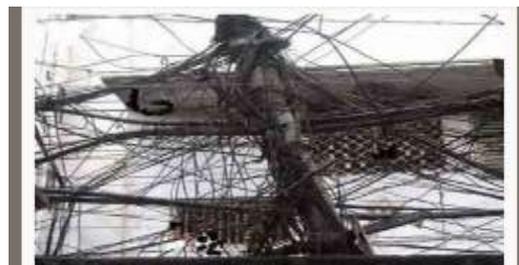


Fig.2. Uncoated Distribution Lin

Total losses incurred by utilities due to electricity theft are huge. As the impact of these losses is huge, it is essential to force the implementation of a mechanism that reduces NTL. Quality of the power generated, transmitted, and distributed, influences the power system components, as well as customer appliances. Illegal consumption of electricity makes the estimation of overall load in real time very difficult. Parameters involved in analyzing electricity theft include political, economic, criminal, and managerial. In addition, priorities in investment on implementation of new measures might also be prone to corruption. Design of future electricity markets is aimed at providing consumers with highly reliable, flexible, readily accessible, and cost-effective energy services by exploiting advantages of both large centralized generators, as well as small distributed power generation devices. A survey of the distribution line of talapara bilaspur chattisgarh in done and possible solution to tackle the power theft problem is suggested.

Electrical theft methodologies: various methods by which the consumers do the power theft are

1. Damaging the electrical meters.
2. Using strong magnets so that the meter gives erroneous reading.
3. Disturbing the pressure coil or current coil of meters.
4. Disturbing the recording unit of meters.
5. Inter-changing the incoming and outgoing terminals of the meter.
6. Illegally calibrating the meters.
7. Direct hooking from the distribution line.
8. Changing the incoming and outgoing terminal of meters.
9. Exposing meters to mechanical shock.

Type of meter used: In most houses the electronic meter is used in the talapara distribution area bilaspur. Although proper metering has not been done in the whole area. Some house don't even use meters and in some houses meter calibration is improper. Fig 3 shows the most common type of meter that is being used in this area.



Fig. 3 Meter Used In Area of Talapara

Proposed methodology for theft control: A generalized algorithm that uses customer energy consumption patterns to detect illegal consumers in a smart grid environment is being proposed. The procedure includes an extensive survey on the methods implemented in pilfering electricity and technologies involved in smart energy meters. Then, an extensive survey on the smart meter and communication technologies are carried out explaining the features of smart grid. In general, utilities collect real-time energy consumption information from its customers several times every day. An encoding algorithm is proposed and implemented, which maps instantaneous customer energy consumption patterns into irregularities in consumption, while preserving the uniqueness in

patterns of different customers. Then, intelligent classification algorithms are developed and implemented to identify illegal consumers. The proposed algorithms are then modified to be implemented on High Performance Computers (HPCs) for faster analysis and identification. Finally, an analysis on the impact of Real Time Pricing (RTP) and Distributed Generation (DG) sources on illegal consumption of electricity is proposed.

Factors influencing illegal consumers : Steal electricity depend upon various local parameters that fall into multiple categories like social, political, economic, literacy, law, managerial, infrastructural, and economical. Of these factors, socio-economic factors influence people to a greater extent in stealing electricity. More concisely, some of the important factors are:

- He belief that it is dishonest to steal something from a neighbor but not from a utility (public or large entity).
- Higher energy prices, unemployment or weak economic situation of a consumer.
- Corrupt politicians and employees of the utilities are responsible for billing irregularities.
- In some cases, total money spent on bribing utility employees is less than the money that would have been paid for consuming the same amount of electricity legally.
- Some consumers might not be literate about the issues, laws and offenses related to the energy theft.
- Weak accountability and enforcement of law.
- Reasons to hide total energy consumption (e.g. Consumers who grow marijuana illegally or small-scale industries to hide overall production/turnover). In essence,
- Electricity theft is proportional to the socio-economic conditions of the consumer.

POWER THEFT CONTROL: Advantages of smart grid and smart meters which enabled the proposed research (in this dissertation) in the real-world and also review the some other method of controlling power theft.

The methods of power theft control are:

1. Using smart meter/nefarious meter inspection
2. Detection & identification based on hvds system
3. Using neural networks/svm model
4. Advanced metering infrastructure
5. Power theft control amr via plc system
6. Intelligent modelling scheme for detection of line losses in power distribution system.

Smart Meter: A smart meter is an advanced energy meter that measures the energy consumption of a consumer and securely communicates this and additional information to the utility. The ability of smart meters for bi-directional communication of data enables the utilities to collect information regarding the electricity fed back to the power grid from customer premises. In addition to secure communication, smart meters can execute control commands remotely as well as locally.

Communication Technology: Utilization of the smart meter system involves a large quantity of data transfer between the utility, smart meter, and home appliances in the network. This data is sensitive, confidential, and access to this data should be given to only a few personnel. With the restrictions on this data, security guidelines are formulated for transmission, collection, storage, and maintenance of the energy consumption data. The communication standards and guidelines were formulated to ensure that data transfer within the network is secure.

Generating Energy Consumption Data

With the advent of smart meters and other smart grid infrastructure, it is now possible to access, collect, and analyze instantaneous energy consumption of customers in real-time. Exploiting such features offered by smart grid, customer energy consumption data is used to classify or identify illegal consumers. However, the energy consumption data required to test the proposed algorithms is unavailable owing to the privacy and confidentiality of utilities and customers. Therefore, this data has been developed using MATLAB in the following procedure. The required data has been carefully developed to match very closely with real-world data. Data about the hourly electricity load on a distribution feeder has been obtained from PJM datasets [61]. This data represent energy consumption of a feeder supplying a large geographic entity or a few neighbourhoods. Therefore, it has been considered that customers on the feeder include several residential, small industrial and commercial customers. There may be several customers in each of the mentioned categories in every neighbor hood. These values of overall load on the grid have been divided among these customers, after assigning a range of energy consumption for each type and range of customers. To this end, all categories of customers on the grid are grouped based on their energy consumption over a period of time. In this analysis, parameters considered for the division are:

Season of year (summer, winter, and the rest of the year)

Types of customers

- Commercial (small, medium, large),
- Residential (small, medium, large)

Table 1 Types of commercial customers based on the ranges of energy consumption

| CONSUMPTION | SMALL | MIDIUM | LARGE |
|---------------|----------|----------------|------------------|
| kWh per month | 0-500 | 500-2000 | 2000-20000 |
| kWh per day | 0-16.677 | 16.677-16.6677 | 16.6677-16.66677 |
| kWh per hour | 0-0.695 | 0.695-2.787 | 2.787-27.877 |

Table 2 Types of residential customers based on the ranges of energy consumption.

| CONSUMPTION | SMALL | MIDIUM | LARGE |
|---------------|-------------|-------------|------------|
| kWh per month | < 300 | 300-600 | > 600 |
| kWh per day | 1.667-10 | 10-20 | 20-33.333 |
| kWh per hour | 0.069-0.416 | 0.416-0.833 | 0.833-1.38 |

Discussion Electrical power system of TALAPARA is distributed in three parts

1. Forward area
2. Backward area
3. Partially forward area

Forward area- In this area distribution line of aluminium wire is replace by the rubber insulating wire 30 percent area comes in that part of talapara bilaspur c.g. In this area some colonies are come in this area medium and high class consumer are live here. Voltage quality level is maintained in this area.

Backward area- In this area because of is totally not improve area. In this area not action taken by the local substation for improvement some region like un educated people and political protection of that area. Hooking is very popular and some other method used to steeling of electricity.30 percent area is that type of area. In that part of area some part of distribution line is rubber insulating wire, illegal consumer by the help of technician line connection or illegal connection is used.

Partially forward area: 40 percent part comes in that type of area. Here meter is mounting out- side of house and line of aluminium wire is replaced by the insulated wire, so that steeling of electricity is controlling but in here some other illegal connection is used by the consumer. In this area two type of connection is used first one is legal connection that connected with light load and second one is illegal connection that connect with highly load. The improvement of this area is increased by the action of local sub station

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