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Distribution Smart Grid with Smart Meters

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Abstract:- Smart grid is the way to control electric consumption, control losses and activate maintenance process, this way lead to reliable grid and avoid over loads.

I. INTRODUCTION

In order to supply all consumers with electricity and get enough power to cover yearly rising in demands, this will not achieve with only build new power plants, but it can achieved through making improvements in distribution system that lead to control and decrease power consumption, the big step in this way is by moving toward smart meters.

Prior to smart meters, electricity consumption was measured with analog meters, which normally had a spinning disc and dials with numbers. The disc would spin faster when energy usage was high, and slowly when consumption was low. Local utility companies would send a human "meter reader" to record data for every home, and customers were billed accordingly.

Smart meters give the impression that data can be altered more easily. However, electricity providers and utility companies are subject to stringent laws in the modern power industry, and smart meters offer many benefits when deployed correctly.

Smart metering delivers accurate and quick measurements and eliminates tedious meter reading home visits. They also enhance reliability, improve customer service, and reduce carbon footprints for a greener environment.

A Smart meter is just a new type of electricity meter. It does exactly the same job as your previous meter, it measures how much electricity you use over time.

The big difference is that rather than having to stick your head in a cupboard or go outside to read your meter, a Smart meter automatically takes a meter reading every 30 minutes and sends this directly to your energy suppliers, so you don't have to submit meter reads yourself. Installation of meters solves:

1- Energy meters record un confidential, it is possible that the reading ±10 to ±20 % .
2- Defective energy meters or Tampering with the electric meter or pulling a line outside the meter
3- Non replacement / calibration of energy meters in time and in right ways.
4- Un-secured energy meters or using several type of meters that lead to inaccurate data
5- Power consumption without meters or theft without legal consuming..

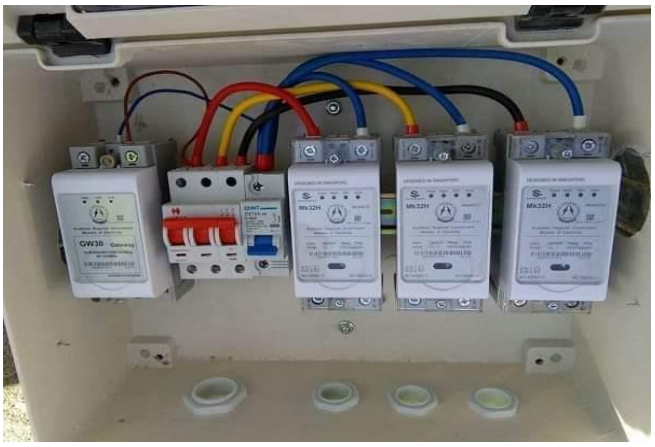

Fig . 1/ Smart meter box

In fig. 1 is the type of smart meters that used in Iraq / Kurdistan region government , this box mounted on electric poles , the meter control the consumption and send reading to the control center , the target of this project are to control electric consumption , overcome overloads and decrease losses .

This box contain one gate way for internet communication and the phase switch for lines and one single phase switch for neutral , it include three single phase meter which supply three consumers with electricity, meters programmed to 40A limitation.

In case of tripping meters due to overloading near 250000 times in Erbil governorate in 3 months shows that consumers passes 40 A restriction , this data is obtained when only ¼ consumers are connected through smart meters .

❖ *How to install smart meters*

In order to install smart meters, the electric authorities have to make a survey with suitable application to entry all consumers to the system in each location or in electric poles if the grid are over head lines, bye this way you will get data about number of boxes that you need and how many meters in each boxes , by this way first step of the process can start , manufacturing :of boxes .

Each boxes indentified by its GPS , boxes will be ready to use.

The installation of smart meters can divide in to work lines :

1- Box and consumer cable installation .

In this process box fitted on the poles or in the building and consumer cable connect to the smart meter and the old electric meter will remain , the data from smart meter will not be taken .

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2- Smart Meter activation.

After installation another team from energy selling who has experience in electric meters will send to start meter activation , the important point in this step is that when the box includes more than one consumer , the process of recognize which meter is belongs to first consumer , therefore the team provide with an instrument with suitable software that allow you to see meters in the box and you can turn off electricity from consumers for seconds , by cutting electricity you can find which meter number belong to any consumers.

After that last reading of old meter record and by pressing activation, smart meter start and old meter will be out of use .

A. How Do Smart Meters Communicate?

Smart meters communicate via wireless technology through a wide area they rely on a wide area network to send meter reading and all data to the supplier, in meter boxes a gateway network mounted to connect meters with the net.

B. Advantages of smart meters?

1. Meter readings facility

When smart meters installed the supplier don't have to send someone to read meters, and consumers don't have to worry about sending meter readings monthly.

Smart meters automatically send out readings to the supplier every two times in one hour, so you the cost of the billing process reduced and time get shorted.

2. Consumer data facility

Through special application or by separate device called CIU, consumer can easily can get data about energy using and cost of consumption. Through this way consumer can reach the information about tariff and cheap times for energy using, so some homes are already showing energy savings of 5-20% when they operate household machines according to organized times. By this way the aim goal of installing of smart meters will be achieved.

3. Accurate electric bills

Mistakes avoided in electric bills in case of using smart meters, because kwh automatically send, so you will always be billed for what you use .

In the past if meter reader cannot reach you meter, the supplier will have to estimate kwh according to billing period or you not be billed. They estimation already done on comparison with the amount of energy that consumer have used in the past or how much they think you will use, sometimes the estimations are inaccurate.

In some cases meter reader record incorrect reading, in the result a big amount of money billed and the process of correcting this case needing a lot off time .

4. Highlights faulty appliances

Electric companies can monitor energy using at any given time because they get readings from smart meters two times in one hours, allowing you to notice any sudden spikes which may be associated with a faulty appliance. By identifying these promptly you can ensure it is dealt with quickly and safely.

5. Saving the planet!

Smart meters improve consumers awareness of energy consumption and rationalization of electrical energy using, by moving toward using more energy efficient appliances that do same service with less power, there is lead to reducing pressure on the electricity grid through decreasing electric load.

6. Tariffs

Electric suppliers are offering exclusive tariffs are amongst some of the cheapest on to consumers who use smart meters exclusive to households, giving consumers plenty of choice to reduce bills, when all this offers will be not be available with old meters.

7. Prepay friendly

Smart meter can be deal with prepay mode and credit mode , i prepay mode helps to reduce consumption to avoid reaching electric cutoff.

'8. Deal with solar and wind power

When customers generate electric power using solar, wind, hydropower, geothermal, or qualified biomass resources. Smart Metering is a means of crediting these customers for energy they supply to the grid while billing them for energy they consume from the grid.

With smart Metering, the kilowatt-hours (kWh) produced by the customer and supplied to the grid offset the kWh supplied to the customer in that month (meaning the customer is billed for net kWh). If the customer sends more kWh to the grid than used, the net kWh used for billing are set to zero that month. Any kWh generated by the customer in excess of the kWh used are accumulated and credited to the customer's account.

'9. smart grid

Smart meters are also main components of smart grids, which make electricity distribution more efficient , smart grid deal with consumers that has own solar and wind power by accounting power back to the grid as easy as possible.

Year	Months	Percentage estimated losses
2021/ mechanical meters	Jan,Feb,March,April	45.21
2022/ smart meters	Jan,Feb,March,April	25.64

Table 1/ Smart meter effect on losses

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Installing smart meter is the first step to move toward smart grids which lead to control consumption and control power losses , table 1 .

For example in case of over loading , the electric authorities can restrict power consumption of consumers till the problem will be fixed for example the consumer will only allowed to use 10A in emergency cases.

Through connecting master meter on Distribution Transformer (DTR) all consumers that connected to this transformer are monitored according to power consumption if any cheat occurred it can be found, this will lead to controlling power losses, if any consumer connected to electric power without meter or in case of passing meter, the system shows that consumption on this transformer are not equal with the master meter.

In addition, present grid systems by using smart meters are designed to meet future requirements such as deal with unidirectional power flow. Integrating additional devices to the smart meter system enhances the capabilities of smart metering technology that lead to more control and improve in electric grid. Geographic Information System (GIS) can be integrated to the smart meter system in order to obtain specific information regarding the geographical location of a potential fault. Quick identification and rectification of faults and other issues that demand the attention of utility company reduces the overall power outage duration .In addition, smart meters reduce the average power outage duration to as less as possible due to their fast response and rectification to power outages and faults.

Fedder 11 kV No.and substation name	Load on 29.09.2020 with mechanical meters	Load on 29.09.2021 with smart meters
11 / Bawaji Koya/ Erbil	90 A	65 A
12 / Bawaji Koya/ Erbil	135 A	90 A

Table 2/ Smart meter effect on load level

Table 2 shows how load decreasing after replacing mechanical electric meters with smart meters, the ratio is about 27% less in consumption if we neglect new consumers that connected during last year on this feeder , This percentage decrease is considered a great achievement and can be considered a success of the project.

Fig . 2 / smart meter installation

❖ *What are the disadvantages of smart meters?*

- Customers have to actively engage with what bills showing and change their consumption based on its information, or they won't see their bills fall..
- Most of the smart meters that have already been installed are first generation devices, which often 'go dumb', or lose functionality, after customers switch suppliers. The second generation of smart meters don't have this problem and most of the first generation meters are slowly being upgraded to prevent the problem.
- Smart meters that technically exist for households on prepayment and time of use tariffs and can make these tariffs easier to manage and find savings with, suppliers have been slow to upgrade their internal systems to offer these variants. The result is that some suppliers aren't offering prepayment and time of use on smart meters yet, this type that in use in KRG are not prepaid type due to difficulty upgrade.
- Not all households have a good radio communication signal outside their house. If the signal is poor the meters cannot communicate to the supplier. In these circumstances a Smart Meter will still be installed but it will be "dumb" and fail to send reading.

❖ *Problems in smart meters*

1- Most people said, when they exit the consumption (meter limitation / Ampere) it take a lot of time to return power .

2- Smart meters need to be fitted by a professional and installation need time , so power should be turn off till the end of fitting.

3- In case of meter malfunction, consumer should contact energy company to repair the problem, this process take a period of time due dealing with network.

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Fig 3 / Meter malfunction

This'll mean carving out some time in your day to be home for an installation, and spending yet another couple of hours without electricity, all so you can get back to where you started.

4-You'll still need to regularly check the meter's data and adjust your usage accordingly, due to that the meter display nothing and installed out of home (in pole mounted type) whether that's by remembering to turn lights off in rooms you aren't using, or by having shorter showers.

5- Smart meters currently report your usage through networks, which can be unreliable in certain areas, particularly if you live in a rural location .This can lead to readings not being sent, which can lead to confusion over bills for both you and your energy company.

6- Smart meters can be confusing and anxiety-producing

Meters can help you to track your energy usage – but constantly being aware of how much you're spending has a downside, particularly for older people on a fixed income.

Some can feel anxiety as they watch the numbers tick up, fall into a panic, and turn off the lights and heating to save money.

Most people aren't familiar with the notion of kilowatt hours, for instance, and though devices will come with instruction manuals, this won't always help.

A better solution may simply be for you to stay aware of your energy usage, and check energy comparison sites to make sure you're getting the best deal.

7- Smart meters Can they be hacked?

Some people worry about the information that sending by smart meters and signals from supplier to the meters, could leak or be hacked into. While no digital platform is completely secure, there are two things to consider:

• The communication takes place over a private network that run by famous companies, not the public internet, making it harder to break into.

• The details shared by smart meters don't include any financial information because it deal only with kwh readings , so any abnormal numbers can be discovered before it get billed.

II. STATUS OF SMART METERING

In general smart meter system includes several control devices, various sensors to identify parameters and devices to transfer data and command signals through soft ware that operate and control the whole system.

In the future Smart meters would play an important role in electricity distribution grids such as monitoring the performance and the energy usage characteristics of the load on the grid, No way to achieve necessary improvements in electric system with mechanical meters.

Power consumption data easily obtained in smart grid that allows the utility companies to manage electricity demand more efficiently and also to advise the customers about the cost efficient ways to use their appliances in order to get less bills and reduce electric demands. Smart meters can be programmed to maintain a schedule for operation of the home appliances and control operation of other devices accordingly. In addition, integration of smart meters helps utility companies in detecting unauthorized consumption and electricity theft in view of improving the distribution efficiency and power.

In case of restrict consumption ,easily done in emergency cases when grid system overloaded by programming smart meters to go to trip if consumers exit restricted kwh according to grid capability.

III. CONCLUSION

Above points explains advantages of smart meter as below :

1- Accurate electric bills .
2- No meter reading efforts .
3- controlling un legal consumers .
4- Controlling power consumption in case of over loads or emergency cases .
5- Reducing losses due less in consumption .
6- More reliability.
7- Easier maintenance process and detecting fault points by using GPS system because all meters and boxes are has GPS positions .
8- Getting all necessary data about electric system grid which are the base of development because nothing will be practice without true and confidential data.
9- In case of growth data , future plan the smart grid give facilities to any study , due to providing accurate information about existing grid.
10- 'In case of shortage in power generation due to nature disasters or technical problems in power plants, it can distribute available power in the grid to all consumers by power restriction through smart meters by restriction consumer power such as reducing it from 30 kwh to 15 kwh.

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