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Making Intelligent Power Distribution Grids

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Abstract

The use of intelligent networks is one of the newest technologies in the electricity industry that has been considered in recent years. Rapid advancement in technology and growing daily consumption are among the main factors that cause the generation and formation of these networks and its entrance to electrical distribution systems. Considering the importance of intelligent networks, this paper introduces intelligent networks and reviews the benefits of using them, and after describing the components of these networks and its standards, some implemented samples in some countries is presented, and finally the results of a practical implementation will be reviewed.

Keywords: Electrical distribution; Networks; Communication technology; Smart grid

Introduction

Smart networks of electricity distribution are one of the world's latest technologies and introduced as the effort of expertise to modernize distribution networks and entering to the new digital century. The main goal is providing reliable electricity to meet the growing needs of customers with minimal damage to the environment (Figure 1).

The first intelligent network was introduced in March 2008 and city of Baldur, in America's Colorado province, awarded the first city with smart networks of electricity distribution. Smart technology has the ability of making major changes in production, transmission and distribution sections, that finally lead to meet the customers' needs and enhancing the output power quality. On the other hand the systems by using collected information, decided to prevent unwanted blackouts in the crisis times [1].

Intelligent network, is a combination of electrical networks, communication networks, hardware and software for measuring, monitoring, production control and manage and energy transmission, distribution and storage. These networks use digital technology to control the power distribution network and choose the best mode for power distribution, that lead to reduction in energy consumption and costs, and increasing reliability and transparency in the network.

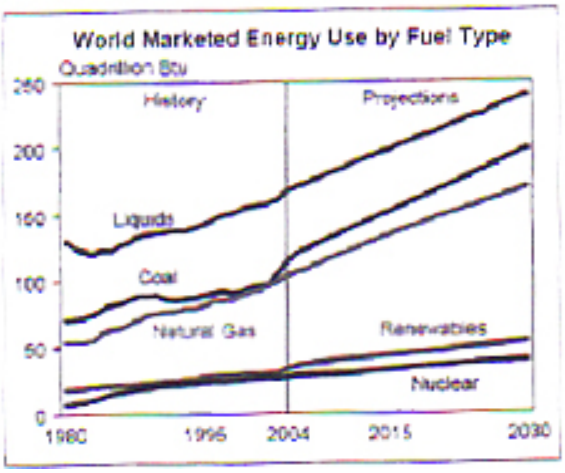

Figure 1: Diagram of annual growth in energy consumption.

Using new technologies enable intelligent networks to control the amount of subscribers' power consumption, and supervising on their consumption amount during peak times, and if necessary turn off the power consuming devices at peak times. Intelligent networks could have protection systems inside the building that allows users to manage their energy consumption better. Even intelligent networks allowing independent energy sources, like; home solar cells or geothermal energy systems to inject their energy to the network.

Next, after introduction of intelligent networks types and its benefits, the structure of these networks studied and an implemented practical example of this network will be reviewed [2].

Each communication technology has its own merits and limitations that must be evaluated to determine the best communication technology for electric system.

The Types of Intelligent Networks

Three generations of intelligent networks (that have emerged by now) are as follows:

First generation focused on the development of electricity network capacity and issues like; remote access to these networks that among them issues such as network control, reliability and integration of renewable energy sources is very important.

Second generation mainly focused on issues related to distribution and subjects such as; capability and quality of power distribution systems. These networks main performance is providing alternative network capacity for network equipment's in network's various states. This approach focuses on the distribution automation and don't deal with network other indicators such as, advanced metering infrastructure and demand side management.

Third-generation, generate Through second generation

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development and using intelligent networks key indicators such as; demand side management, advanced metering infrastructure, outage management and Customer information system [3-5].

Necessary Infrastructures to Launch Smart Grid

Communication and measurement equipment's

The first step in developing a distributed intelligent network is generating high-speed communication between measurement devices and control centers. The most affordable type of communication is the use of power lines for data transferring. Regarding measuring equipment's, smart meters are being produced now. This meter has the following features:

A) The ability of consumption measuring at an interval.

B) Two–way communication between the consumer and center-based software.

C) Saving consumer's joint records.

D) The ability of automatic and remote meter reading.

E) The percentage of standard error.

Intelligent posts and feeders

One of the goals of intelligent distribution networks is monitoring equipment features including; power, current and voltage, as well as monitoring real time of the whole distribution system and applying the orders, which this work is done by the help of intelligent posts and feeders.

Intelligent posts: Improving infrastructures, posts' better monitoring and adopting it by subscribers' needs. Thus allowing real-time decisions based on the conditions that will lead to increased network stability and blackout reduction.

Intelligent feeders: There is the need to intelligent re belting and controllable switches in the feeders section. With Costing and improving the feeders, the control center will be able to monitoring current, power, current cut off, measuring addition voltage, and if necessary, remote current connecting and disconnecting to prevent damage to equipments.

In summary, by using intelligent posts and feeders the following results obtain:

a) Load detection and isolation for snapshot errors and network errors.

b) Allowing automatic turn on-off switches between feeders and automatic maneuvering between the posts.

c) The ability to make a quick recovery after a network error occurred. (Elimination of labor for remote troubleshooting with remote controlling equipments replacement).

d) System customers' ability to see current and load when Demand intelligent management.

e) Providing a choice for energy management based on real-time price signals.

f) Ability to view and register post conditions.

Intelligent meter reading system

Intelligent meter reading system refers to a system that Measure, collect, analyse and control the distribution of energy by the help of advanced distribution automation equipment's. Intelligent measurement systems are integrated systems, including hardware, software, networking and communications platform that received information such as; consumption, demand, voltage, current and other real-time information from consumer. Also this system is equipped with reading data management software. Considering intelligent meter reading system is responsible for integrating measuring and managing process of distribution networks, so operators are able to optimize the available network. It is possible for distribution network beneficiaries to optimize data, services and new data for customers. Intelligent measuring meters must have the ability of exchanging information with the distribution companies, be equipped with remote off-on relay, phase and null current measurement system, and meter manipulation diagnosis system [6].

Using telecommunications infrastructure enables intelligent network to establish two-way communication with customers, and using received signals get the best result. Telecommunication between different areas is one of the important parts of intelligent network infrastructure (Figure 2).

Control center or centers

These centers include hardware and software applications such as; load management program, billing system, load prediction and data analysis programs, relation with market and tariff management, that permanently through intelligent meter reading system are associated with the distribution parts.

Benefits of Intelligent Networks

As mentioned, one of the main benefits of intelligent networks is their interaction with energy producer companies and also distribution companies as energy consumers. These networks allow the presence of disperse generators and virtual power plants (VPP) in the network (Figure 3).

In summary, the advantages of intelligent networks are as follows:

1. Peak reduction that is the main result of deployment of intelligent network.

2. Reduce power system losses.

3. Reduce the consumption of fossil fuels, thereby reducing peak and energy losses and also reduce the decline in distribution lines.

4. Reduce system blackouts.

5. Reduce the investment required for transmission and

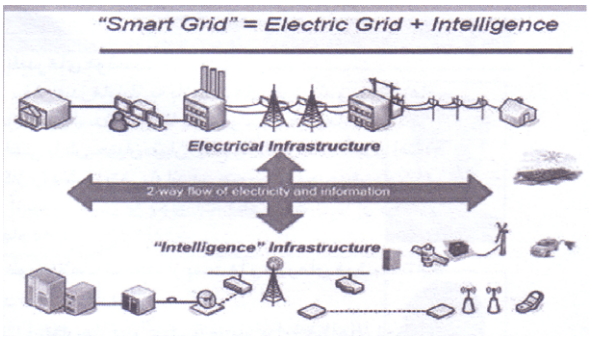

Figure 2: The way of intelligent network communication.

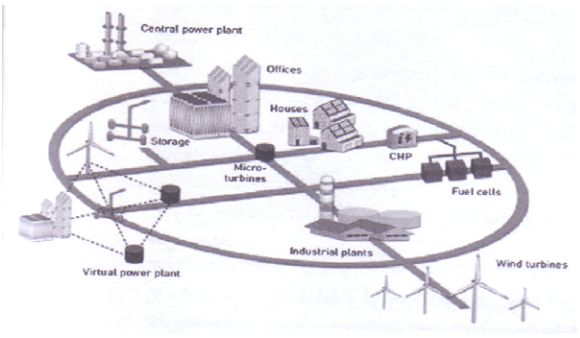

Figure 3: Intelligent network and disperse generators interaction.

distribution projects to improve load balance and reduce because of load management.

6. Reduce the costs of meter reading, maintenance, and subscribers' current off-on through intelligent reading systems.

7. Reduce operating costs.

8. Increase network stability.

9. Improve the protection system.

10. Improve power quality.

11. Increase reliability.

12. Demand side better managing, due to direct relation with the equipments.

13. The decentralization of power production so that subscribers can be consumers and producers at the same time.

14. Increase flexibility for subscribers in selecting power supplier.

15. The possibility of developing new energies, wind turbines, solar cells and fuel cells in all parts of the network.

16. Reduction of environmental pollutants.

17. Precision in the measurement and lacking delays in data access.

18. Reduce the need for spinning reserves.

19. Improve receiving claims and demands systems and reduce delayed claims because of subscriber's remote current off-on possibility, due to intelligent reading systems.

20. The possibility of electricity presale and preparing it to electricity retail market.

21. Increase options of power sales with different prices and the possibility of electricity presale.

22. Create proper ground for developing e-government services.

23. Increase accuracy and speed in billing by eliminating the human factor (due to the intelligent reading systems

24. No need to reading officer's presence at the site

Smart Grids Standards

IEC, NIST are among the leading organizations in the field of standardization of intelligent networks. In the NIST standards, referred to some applications of intelligent networks as bellow: Response to consumption demand and energy consumption efficiency, energy storage, electricity transportation, intelligent measurement system and power distribution management. The IEC standard priorities are such as; power outages, distribution management and automation, distributed energy resources and smart homes. IEC standards mainly are in the field of electronics and related technologies such as generation, transmission and distribution, meanwhile The NIST main activities are regarding connecting buildings to the smart grid and information safety and security issues [7,8].

Estimated Costs of Building a Smart Grid Model

In this part an economic survey performed, considering equipments installation and supplement related costs, in addition estimates cost for installation a smart network model. With this economic assessment, the amount of required costs and required time to costs returning is recognizable.

Costs associated with equipment supplies and installation is as follows:

a) The price of per smart meter unit about 7/0 million Rials.

b) The price for wireless devices for anywhere about 5 million Rials.

c) Optimization Cost of each post and each feeder, respectively, 28 and 15 million Rials.

In this case, for example, a city with 50 thousands subscribers, 2 distribution post and 10 output feeders, the costs will be as Table 1.

As shown above, the total amount of annual 4/4 Milliard Rials, show a reduction in costs, given that almost 35 milliards, of startup costs is returnable in 8 years.

Implemented Samples

In this section, some smart grids implemented examples in some countries introduced, to explain this field's goals and activities.

Italy

Enel Company in Italy decided to implementing smart meters in the late 20th century. According the decision of this country, the project's study, conducting from 2001 to 2008, and during this period 31 million smart electricity meters was installed.

France

In this country planning for the implementation of intelligent networks will begin from next year and will be in three stages as follows:

1. From 2012 January, any meter that is installed must be smart.

2. By the end of 2014, 50% of smart meters should be connected to the intelligent measuring system.

3. By the end of 2016, 95% of smart meters should be intelligent.

Netherland

The Dutch government, seeking solution for energy saving, in minor energy consuming sections after approving the Energy Tax Act in 2007. According this Act, electricity and gas meters by 2013 should be of type intelligent and the purpose of doing this is to reduce greenhouse gas emissions.

Conclusion

This paper deals with the brief introduction and study of intelligent

Costs	Million Rials	Saving	Million Rials
The cost of Intelligent Measuring devices	35000	Reduce 50% of meter reading and receiving demands each year	600
The cost of Wireless equipments	50	Reduce meter inspection and installation costs	800
The cost of optimization 2 posts	56	Reduce Service and maintenance costs	1000
The cost of optimization 10 feeder	150	Reduce exploitation costs	2000
The cost of other required equipments	100		
Total Costs	35356	Total saving costs	4400

Table 1: The amount of costs and saving in costs, in establishing an intelligent network model.

networks.in summary, the main purpose of intelligent networks is providing reliable electricity to meet the growing needs of customers, with regard to environmental standards. In this paper, after introducing these networks and its kinds, required equipment's, including hardware and software structures are needed for telecommunication were introduced then the major advantages and applications of these networks is presented and Finally, several implemented examples in various countries were studied. Given the aforementioned benefits of intelligent networking including; technical, economic, environmental and even social advantages, Countries need to move towards this new technology. According the goals of country's electricity industry to manage consumption, reduce losses, privatization, reduce costs, improve revenue collection system especially, according the law of making subsidies targeted, movement toward creating intelligent networks seem to be inevitable.

References

1. http://WWW.smartgrids.es
2. http://WWW.iec.ch/smartgrid/mappingtool
3. http://WWW.saba.org.ir
4. http://WWW.matnintl.ir
5. http://WWW.eranet-martgrids.es
6. Intelligent Network and Intelligent Metering Seminar, Sharif Industrial University, Ordibehesht 89.
7. Mostadampour K (1389) The Survey of available standards in electricity intelligent networks, 25th Electricity international Conference, Power Institute.
8. Gungor VC, Lambert FC (2006) A survey on communication networks for electric system automation. Computer Networks 50: 877-897.