Department of Electrical Engineering
Assignment
Date: 14/04/2020

Course Details

Course Title: Smart Grid Technologies **Module:** 3
Instructor: _____ **Total Marks:** 30

Student Details

Name: Jawad Shah **Student ID:** 15550

INSTRUCTIONS:

1. Answers to all the following questions must be submitted in form of one *Research Paper*.
2. Each answer must be supported by related research articles (at least 3)
3. The answers must be in your own words and references must be cited wherever it is necessary
4. Plagiarized content will NOT be accepted (Max allowed similarity Index: 15%)
5. The solution must be uploaded before the end of deadline mentioned on the *Online Portal* of subject.

Questions

1) Present in detail the problems and limitations of existing electric grid. How does unreliability of existing grid system results in loss of billions of dollars to the consumers?
2) Why should pursue a smart grid? If it should, what functions should the smart grid address?
3) Smart grid is customer oriented. What does this term mean and how does this relate to efficiency of grid?
4) Are customers interested in receiving advanced energy and other informational services through the electricity grid? How can this have monitory benefits for the customers and other stakeholders?
5) A smart grid network consists of a number of components. Discuss the its major components and operations in an integrated system.

Name = Jawad Shah DEPT: MS Electrical Engineering Subject= Smart Grid Technologies ID No.15550

Abstract

This paper is about the problems and limitations of existing electric grid, unreliability of existing grid system which results in loss of billions of dollars to the consumers. The benefits and significance of Smart Grid that and How can smart grid have monitory benefits for the customers and other stakeholders and what are the main components and operations in an integrated system.

Introduction

A smart grid is an intelligent electricity grid that optimizes the generation, distribution and consumption of electricity through the Communication Technologies on the electricity grid. provide automatic management of the electrical networks, allow better measurement of consumption, improve the existing services which lead to energy savings and lower costs.

I. problems and limitations of existing electric grid

Obsolete System Layout : With the passage of time the population increases and as well as the demand of electricity also increase while we have still the old electricity networks and substations which is not enough to fulfill the requirements of present population so that areas requires serious additional substations sites.

Aging Infrastructure of Current Grid : older equipment have higher failure rates, leading to customer interruption rates affecting the economy and society, also older assets and facilities lead to higher inspection maintenance costs and repair/restoration costs.

Outdated engineering of Current Outdated engineering of Current Grid: Traditional tools are ineffective in addressing current problems of aged equipment, obsolete system layouts, and modern deregulated loading levels.

Old cultural value: planning, engineering, Operating of system using concepts and procedures that worked in vertically integrated industry exacerbate the problem under deregulated industry.

II. unreliability of existing grid system

Unreliability of existing grid system results in loss of billions of dollars to the consumers, because when the Electric power grid is unreliable the supply of power is not continuous due to which outages, interruption and Blackouts occurs due to which the consumers losses billions of Dollars. In America in 2003 Blackout 4-6 Billion Dollars loss occurs and about 50 million peoples effected from that blackout.

III. Why should pursue a smart grid

The objective of the Smart Grid is to update electricity infrastructure which includes more advanced communication, control, and sensory technology which increase communication between consumers and energy producers. Also increased reliability, more efficient electricity use, better economics, and improved sustainability many countries have been pursuing a Smart Grid so we also should pursue a Smart Grid

IV. Functions the smart grid address

Functions which Smart Grid Address is Power Quality, Power System Reliability, The Smart Grid has selfheal ability, it also have Energy Storage System, Privacy and Security and Renewable Energy Integration. [https://www.researchgate.net/figure/Key-functions-of-smart-grid-110_fig16_311210933]

V. Customer Oriented Smart Grid for Energy efficiency

Customer orientation is defined as an approach to sales and customer-relations in which staff focus on helping customers to meet their long-term needs and wants. [https://smallbusiness.chron.com/customer-orientation-examples-10201.html]

Mainly based on interactive wireless electrical infrastructure, smart outlets and smart light switches, which provide low installation costs. As opposed to conventional smart home solutions that utilize a complex set of sensors for human detection, user awareness is achieved without specific sensor devices. The automation system intelligently controls power consumption of appliances, contributing to energy savings in the household. [https://www.researchgate.net/publication/235919616_Consumer-oriented_Smart_Grid_for_Energy_Efficiency]

VI. Customer Interest in Receiving advance energy and Information

Customers are interested in receiving advanced energy and other informational services through the electricity grid because there are so Many benefits for the customer in Smart Grid which are follow:

1. Reduction in outage duration and Frequency
2. Improved public and Worker safety
3. Reduction of Prices
4. Electric Losses Reduced
5. Automatic Control on home appliances which helps to Reduce the extra charges of electricity and and minimize waste of Electricity.

VII. Monitory benefits for the customers and other stakeholders

The Monitory benefits for the customer is that Smart grid Monitors the whole system i.e from Transmission lines to home appliances. Where it monitors transmissions lines for detection of fault and and overcome the breakdown by self healing method automatically. Smart grid can provide a new set of tools for consumers to manage their usage and total energy bills. Smart grid technology makes it easier and cheaper for consumers to see their electricity use and to have access to value-enhancing dynamic pricing also in home it monitors all the electronics like AC , Refregirator, Electric Heater.. etc which automatically turn off the AC in peak hours and other appliances when there is no need.

VIII. Benefits for the stakeholders

• **Large Customers:** Industrial customers require access to information, including price signals, to make efficient energy decisions. A smart grid will provide additional benefits from more detailed information and better reliability. A smart grid will allow large customers to integrate their production, storage and efficiency investments easily into wholesale market operations.

• **Local Governments:** Local governments can benefit from higher reliability and lower duration of outages that will reduce the burden on local fire, police and other city resources that must help with such events. Greater information and control over the distribution system will also allow grid operators to assist with emergency situations, Local governments are also consumers of electricity and can take advantage of the consumer-related benefits of smart grids.

• **Utility/Grid Operators:** Grid operators will benefit from direct cost reductions. Direct cost reductions can come in the form of lower meter reading and servicing costs, avoided meter capital costs on existing meters, more efficient deployment of field staff as a result of better information on grid conditions, labor and non-labor operations costs savings, improvement in efficiency of billing, customer connections, and many other utility processes. Other benefits include reductions in working capital needs, reduction in bad debt expense, reduction in theft and energy losses, improved and more efficient customer service, more efficient planning and maintenance of the system, and more efficient use of back office resources.

IX. Major Components and operations of Smart grid in an integrated system

- **Generation and Bulk Transmission:** Energy-efficient transmission network will carry the power from the bulk generation facilities to the power distribution systems. Communication interface exists between the transmission network and the bulk-generating stations, system operator, power market, and the distribution system
- **Distribution System Optimization:** Integration of distribution generators (DG) of all sizes and technologies (photovoltaic, wind generation, small hydroelectric generation, biomass generation, etc.) should be enabled in the medium and low voltage distribution networks so as to ensure the maximal production of electric energy from those resources. To optimize operation and usage of distribution network infrastructure Decreasing peak loads, postponing capital investments (building new elements and/or upgrad-ing existing elements), and reducing power and energy losses should be enabled by using:–SG components, such as DG, energy storages (ES), microgrids, plug-in electrical ve-hicles (PEV), AMI systems, smart appliances in households/commercial, home area network (HAN), smart sensors, etc. new/advanced tools for managing distribution networks – advanced distribution man-agement systems (DMS), and– in addition, improvement of asset management and especially maintenance strategies should be enabled by using higher volume and quality of data gathered through SG components – AMI systems, smart sensors, intelligent electronic devices (IED).
- **Smart meter end user Technology:** A smart meter revolution is underway throughout the US, Europe, China and Japan, with wireless, data hungry 'smart' meters replacing old fashioned 'dumb' meters in homes and some businesses. As the change gets underway, we take a look at the technology options available and what benefits they offer. The way consumers and utility companies manage residential and some commercial energy intake is about to undergo a major switch-up. Old fashioned meters will eventually become a minority with compact wireless smart meters becoming ubiquitous.
- The US is already underway with its smart meter programme, with, according to the US Energy Information Administration's website, 493 US electric utilities rolling out 37,290,374 advanced 'smart' metering infrastructure (AMI) installations in 2011

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1. [https://www.researchgate.net/figure/Key-functions-of-smart-grid-110_fig16_311210933]
2. [https://smallbusiness.chron.com/customer-orientation-examples-10201.html]
3. [https://www.researchgate.net/publication/235919616_Consumer-oriented_Smart_Grid_for_Energy_Efficiency]
4. [https://www.power-technology.com/features/feature-smart-meter-revolution-end-user-technology/]

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