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EFFICIENT ENERGY PERFORMANCE WITHIN SMART GRID

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Abstract: The Smart Grid, regarded as the next generation power grid, uses two-way flows of electricity and information to create a widely distributed automated energy delivery network. Energy/power plays a critical role for social, economic and industrial development. Because of industrial generalization, especially in agricultural and economical activities, the energy demand has increased rapidly in developed countries. Generation and usage of energy has direct impact on modern power grid. In this scenario energy management is a hard task because load is dynamic and we don't have control over it. Renewable or undepleted energy resources have great applications and impact in current electric power system situation. For example it gives pollution free (green) energy which is environment and user friendly. It is cost effective; it uses natural resources for its generation and hence do not waste any coal, gas etc. There are many inducements to empower energy productivity. As current smart grid is complex and nonlinear in operation and design, it used an optimized method that provides maximum efficiency with minimum input. Our work depicts a case study of hybrid electric aircraft for achieving high performance.

1. INTRODUCTION

TRADITIONALLY, the term grid is used for an electricity system that may support all or some of the following four operations: Electricity generation, electricity transmission, electricity distribution, and electricity control. Energy/ power is a vital input for economic and industrial evolution. The fast advancement of world economy, power needs rushed exceptionally, specifically among developing states. SG responds to wide ranging events and has a number of categorization due to its wide usage in various systems as smart electrical/power grid, sharp grid and imminent grid. SG is inducted in all energy power sources and in system of power and energy generations for optimum marketing, commerce and better management. The core prospect is to bring both the active customer participation and decision making at one grid and creating a working environment for both utilities and electricity users to address each other. DRPs in the Utility field enhance consistency via distributed generation or energy storage at substations, and overall giving the automated control to the grid. SG measurement and verification resources work in a system of sensors, communications system, computer hardware and software. The software's enable monitoring, communication and analysis of the consumption of energy resource in the entire grid by comparing it with software data for gauging the performance of the resource. The energy resource has to be present in the entire grid during the process of measurement and verification. Efficient energy management and distribution is empowered through DR. A series of devices function collectively with advanced software system for enabling DR. The software assets include AMI, communication systems, computerized building systems and complex devices. Measurement resources play an essential role of operating and running basic SG operations. These functions include automated meter reading and conveying cost signals. Validation, measurement and authentication are additional benefits and minimal amount is required for installation. SG is a robust and efficient system that ensures reliability, efficiency, flexibility and delivers power in a controlled and smart way lowering peak demand. Investments are done in power sector to increase growth, development and to provide utility to consumers. By improving technology the grid will become a self-healing system and incorporating energy storage devices, renewable energy, and AMI and demand response programs will stabilize the grid.

All these features of SG make grid resilient and suitable for existing energy demands and future needs.

2. DESCRIPTION

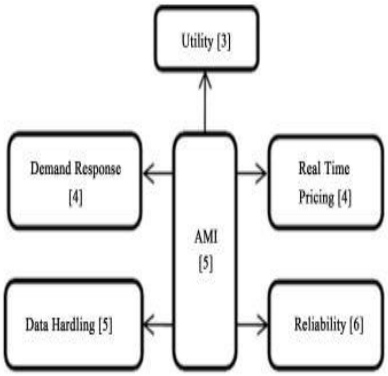
INTEGRATION OF RENEWABLE ENERGY IN SG

Demand of renewable has increased and 19 percent of the world electric energy share is of renewable energy out of which hydroelectric power makes 83 percent. Shifting to renewable technology is necessary for green house security and to increase energy and resources security. As a result renewable energies and distributed generation are getting assistance and their stakes in electricity generation are increasing. Table illustrates the benefits of renewable energy. The growing renewable production is the major concern for people working for development in SG system and the introduction of distributed generation to the electrical distribution system has been the key driver in the evolution of distributed system. However integration of renewable is not getting the desired market attention nor has participation in system management. Renewable energy utilization in SG

is increasing and supports the grid by improving power quality, reliability and reducing cost. Climate change has become a problem and to address this issue renewable energy resources are preferred and it provides grid stability

-Advanced Metering Infrastructure

AMI measures the quantity of energy used, analyzes how it is used by identifying the problems and reads the actual energy consumed by a consumer. AMI is considered the base of SG and enable consumers to use electricity more resourcefully and efficiently by informing consumers about detected problems on their systems. Figure describes the advantages of AMI. Automatic meter reading system differs from conventional meter. Automatic meter reading system is bidirectional and has various advanced features such as power theft applications, two way communications for real time data and has information regarding grid and user conditions. AMI comprises of smart meters and communication networks. The AMI system is connected to the management system, customer information displays and smart devices. Thirty percent reduction can occur in the demand during peak hours with the AMI in vogue. Installation of AMI improves consumption in a logical, economical and efficient manner.



3. Advantages and Disadvantages of Renewable Energy

-Advantages

a) Easily Regenerated

b) Boost Economic Growth

c) Easily Available, Support Environment

d) Low Maintenance Cost.

-Disadvantages

a) Weather Dependency

b) High Installation cost

c) Noise caused by Wind Energy

d) Fluctuation Problem (Solar)

e) Intermittency Issue (Wind)

4. CHALLENGES IN ENERGY EFFICIENCY MODELING

Energy efficiency modeling is of great concern within the field of smart grid (SG). The SG implementation needs variety of improving constraints and challenges. Efficiency modeling is achieved by the implementation of optimization schemes. A massive information set is needed to assign totally different modeling techniques on the principle of various constraints and challenges rising inside the field of smart grid. The definition to the optimization is that the procedure adopted to implement totally different techniques for locating conditions to maximize the profit or in alternative words to reduce the price of whole process.
The communication infrastructure of a SG is a system that is a combination of various systems and is very much complex. While modeling, analyzing and designing a communication infrastructure, a number of new challenges are required to meet. As a way to describe emerging behavior, the communication models that are being proposed are required to have the ability of accounting for uncertainty. The numeric tools used to solve very large scale problems must have the capability to perform analysis. As a fact the power system is a non-linear and very tightly coupled system. The communication infrastructure will be designed specifically to degrade control system and time required to manage elastic or graciously uncertainties and inconsistencies. The complexity of a SG communications infrastructure modeling challenges are encapsulated as: It is not possible to easily simulate electrical sub-system as it is tightly interconnected (Required to aid multi-physics approach). While considering various factors (power flow, control, and communications) different users are required to work at the same scenario (need to support multidisciplinary approach)

5. CASE STUDY

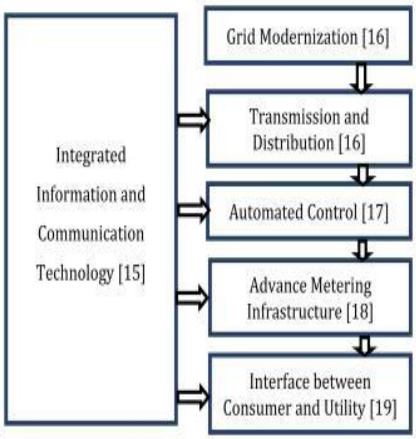
Energy efficiency modeling is of great concern in the field of smart grid. Depending on the type of energy management strategy selected, the energy management system controls the power of each energy source devices through the reference signals (output voltage and maximum current). Efficient energy management and distribution is empowered through different program and their control. For efficient energy management and distribution DR is introduced. Sustainability plays essential role in efficiency. A case study is presented here for analysis of high energy efficiency performance. A hybrid electric aircraft model is implemented for analysis, results came from model are discuss briefly. Fig presents a block diagram of hybrid aircraft model, implemented in MATLAB. Model results are analyzed and discuss. Results include:

- Signal generator/ builder
- AC load stator current
- Electromagnetic and electrical torques
- Armature current
- Speed Characteristics

A signal generator/builder is an electronic device that generates repeating or non-repeating electronic signals in either the analog or the digital domain. It is generally used in designing, testing, troubleshooting, and repairing electronic or electro acoustic devices, though it often has artistic uses as well. There are many different types of signal generators with different purposes and applications and at varying levels of expense. These types include function generators, RF and microwave signal generators, pitch generators, arbitrary waveform generators, digital pattern generators and frequency generators. In general, no device is suitable for all possible applications. Figure 4 represent power aircraft turbine signal. Signal magnitude varies with respect to time. At time 0, signal start from −5000 and grows linearly with time, at time 0.5 sec signal magnitude is 12,000 and is stable up to 2 sec, after that it decays to 10,000 than suddenly increases to 20,000. Signal magnitude varies because of dependency on too much factors and can be adjusted according to desired output. A function generator is a device which produces simple repetitive waveforms. Such devices contain an electronic oscillator, a circuit that is capable of creating a repetitive waveform. (Modern devices may use digital signal processing to synthesize waveforms, followed by a digital to analog converter, or DAC, to produce an analog output). The most common waveform is a sine wave, but saw tooth, step (pulse), square, and triangular waveform oscillators are commonly available as are arbitrary waveform generators (AWGs). If the oscillator operates above the audio frequency range (>20 kHz), the generator will often include some sort of modulation function such as amplitude modulation (AM), frequency modulation (FM), or phase modulation (PM) as well as a second oscillator that provides an audio frequency modulation waveform.

6. CONCLUSION AND FUTURE WORK

Efficient control of power systems is becoming increasingly difficult as they gain in complexity and size. Computerized power management system with fast and optimal communication network overcomes all major discrepancies of undue or inadequate load relief that were present in old conventional systems. This paper presents the basic perception, challenges and analysis of efficient energy performance within smart grid. Possible research direction that is essential to determine the control strategy potential for practical application is the utilization of more detailed system models both on the generation and load side. Generators can be more accurately represented by fifth or sixth order model that incorporate the effects of automatic generation control systems together with the influence of damper windings, armature voltage etc. On the other hand, the loads can be modeled as being voltage and frequency dependent instead of the passive constant impedance model used currently. All these questions will be a subject of our future research.



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