

A Review on Integration of Renewable Energy Sources in Smart Grid System

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Abstract— This paper provides the basic principle of power generation from renewable energy. Smart grid technology is the key for an efficient use of distributed energy resources. The smart grid is the future conversion for the techniques and strategies of production and the interaction of all the components of power grid. But the energy produced is not sufficient to meet our current and future needs. For that renewable energy is the only long-term solution. Salient features of the Smart Grid are stated and pre-requisite features required to be implemented for renewable energy integration are explained. This paper presents the overall study of integrating renewable energy in smart grid and the various challenges that are faced during integration.

IndexTerms—: Smart grid, Renewable energy resources, Distributed Generation (DG).

I. INTRODUCTION

The energy has become a basic need for the human beings, enabling a better lifestyle. Smart grid technology is an extended form of analog technology that has also been introduced for controlling the use of appliances by employing two-way communication. However, the prevalence of Internet access in most homes has made the smart grid more practically users, operators and automated devices to quickly respond to changes in smart grid condition systems. A smart grid is an electricity network based on digital technology that is used to supply electricity to reliable to implement. Smart grid devices transmit information in such a way that enables ordinary consumers via two-way digital communication. This system allows for monitoring, analysis, control and communication within the supply chain to help improve efficiency, reduce energy consumption and cost, and maximize the transparency and reliability of the energy supply chain. The smart grid was introduced with the aim of overcoming the weaknesses of conventional electrical grids by using smart net meters. Many government institutions around the world have been encouraging the use of smart grids for their potential to control and deal with global warming, emergency resilience and energy independence scenarios.

II. THEORY

SMARTGRID

A smart grid is the solution to the modernization of the electrical energy system and infrastructure to present a more intelligent and reliable electricity grid. Smart grids provide many benefits over conventional grid. Smart grids improve both the physical and economic operations of the grid system, increasing reliability and sustainability.

Need For Integrating Renewable Resources,

Salient features of Renewable Energy sources that impact their integration into power grids are their size of generation capacity as compared to other sources of power generation on a system, their geographical location with respect to network topology, and their variability of output which critically depends on time and climatic conditions. Smart grid technology can control renewable resources to effect changes in the grid's operating conditions and can provide additional benefits as distributed generation assets or when installed at the transmission level. Small, electricity-generating systems located at or near the place where the energy is used and connected at the distribution level are referred to as distributed generation.

General features of smart grid

Smart grid has different aspects and can be characterized as follows:-

1. Interactive with users and markets
2. Adaptive and scalable to varying situations
3. Self-healing grids with advanced automation
4. Integrated, merging monitoring, control, protection,
5. Secure & reliable
6. Cost efficient

7. Provides real time data and monitoring

III. LITERATURE REVIEW

Sushmita Banerjee in [1] authors has proposed Smart grid technology is the key for an efficient use of distributed energy resources. The smart grid is the future conversion for the techniques and strategies of production and the interaction of all the components of power grid. Noting the climate change becomes an important topic of concern, the whole world is currently facing the ever increasing price of petroleum products, coal etc and also the reduction in cost of renewable energy power systems, giving opportunities for renewable energy systems to address electricity generation. However, to achieve this task, an efficient energy management system needs to be addressed. In this context, the concept of smart grid plays a crucial role and can be successfully applied to the power systems. This paper presents the study of integrating renewable energy in smart grid system. The introductory part provide the role of renewable energy and distributed generation in smart grid system The concept of smart grid renewable energy system and its applications along with the PV smart grid system are also been discussed and studied.

Sushma Sekhar in [2] authors has analyzed India is a growing economy with an ever increasing energy requirement. But the energy produced is not sufficient to meet our current and future needs. With depleting fossil fuel reserves and concerns about its environmental impact, renewable energy is the only long-term solution. This paper provides the basic principle of power generation from wind and solar energy. An over view is presented regarding the challenges of integration of this energy with the conventional grid and how these challenges can be overcome by the implementation of a Smart Grid. Salient features of the Smart Grid are stated and pre-requisite features required to be implemented for renewable energy integration are explained.

Anil K Jain in [3] authors has proposed With the ever increasing growth of renewable energy sources, in the years to come it is really a challenge to integrate the same into the smart grids in a country like India. This is basically on account of unevenly distributed renewable resources. With 5 regional grids gradually getting connected, formation of national grid in totality is a reality. Smart Grid technologies provide enhanced opportunities for the utility of the future. Smart grid comprises of a number of technologies and concepts. These technologies can provide greater advantages when used co-actively with other smart grid technologies. The importance of integrating these technologies grows, as carbon control and environmental policies and standards evolve and come increasingly into action. Integration is the process of connecting a distributed generation system to the electric grid. With a growing array of diverse distributed and renewable generation, utility managers face complex technical and capital challenges in planning, designing, and maintaining transmission, distribution, and generation assets. Smart grids promise to facilitate the integration of renewable energy and will provide other benefits as well. Smart grid considers enhancement of all parts of power systems (from a generation part to a consumer part). This paper presents the overall study of integrating renewable energy in smart grid and the various challenges that are faced during integration.

Gustav R. Grob in [4] authors has proposed Transportation is facing fundamental change due to the rapid depletion of fossil fuels, environmental and health problems, the growing world population, rising standards of living with more individual mobility and the globalization of trade with its increasing international transport volume. To cope with these serious problems benign, renewable energy systems and much more efficient drives must be multiplied as rapidly as possible to replace the polluting combustion engines with their much too low efficiency and high fuel logistics cost. Consequently the vehicles of the future must be non-polluting and super-efficient, i.e. electric. The energy supply must come via smart grids from clean energy sources not affecting the health, climate and biosphere. It is shown how this transition to the clean, sustainable energy age is possible, feasible and why it is urgent. The important role of international ISO, IEC and ITU standards and the need for better legislation by means of the Global Energy Charter for Sustainable Development are also highlighted.

M. A. Islam, M. Hasanuzzaman in [5] authors has proposed Energy is an indispensable factor for the economic growth and development of a country. Energy consumption is rapidly increasing worldwide. To fulfill this energy demand, alternative energy sources and efficient utilization are being explored. Various sources of renewable energy and their efficient utilization are comprehensively reviewed and presented in this paper. Also the trend in research and development for the technological advancement of energy utilization and smart grid system for future energy security is presented. Results show that renewable energy resources are becoming more prevalent as more electricity generation becomes necessary and could provide half of the total energy demands by 2050. To satisfy the future energy demand, the smart grid system can be used as an efficient system for energy security. The smart grid also delivers significant environmental benefits by conservation and renewable generation integration.

Clark Koenigs in [6] authors has proposed Smart grid has strong potential to advance and encourage renewable energy deployment, but given the multiple motivations for smart grid, renewables are not always central in smart grid policy discussions. The term "smart grid" represents a set of technologies, including advanced meters, sensors and energy storage that are crucial for the integration of more renewable and low carbon electricity into the electric power grid. However, developing and building a smart grid is jurisdictionally complex, path dependent and context specific; states and regions are approaching grid modernization in different ways. This paper reports on a comparative analysis of smart grid development in seven U.S. states. We use state-level policy documents to learn what motivates smart grid development and how smart grid is framed in relation to renewable energy.

In some states, renewable technologies are presented as an integral part of the smart grid policy discussion, while in others they are largely absent.

Mrs. N. V. Vader in [7] authors has proposed As electricity demands are increasing day by day causing unbalance in the present grid system which results in various causes like load shedding, unbalance voltage etc which ultimately affects the consumers. Now to avoid all such situations the only option is to meet the demand by increasing generation but, we are also lagging with the conventional sources so generating more power is also not convenient by conventional ways. Thus, use of Renewable is quite important. The solar power reaching the earth's surface is about 86,000 TW. Covering 0.22% of our planet with solar collectors with an efficiency of 8% would be enough to satisfy the current global power consumption solar have tremendous potential for fulfilling the world's energy needs.

Smart grids promise to facilitate the performance of the grid system. The power industry has adopted "smart" grids that use information and communication technologies, which may make electric power systems more reliable and efficient. Renewable technology enhances the available energy resources. These technologies also enable integration of higher levels of renewable energy and conventional energy sources. The renewable sources are not "dispatch-able"—the power output cannot be controlled. Future energy sustainability depends heavily on how the renewable energy problem is addressed in the next few decades. Solar energy can be made more economical by reducing investment and operating costs and by increasing solar plant performance. Integration of solar system with the smart grid have to come up with the challenges put forward by solar systems like technology barrier, uncertainty, social impact, economical aspects, free acceptance etc.

Several countries have adopted special programs to subsidize and promote solar energy. Among the most successful ones are the Feed-In-Tariff (FIT) programs and the Production Tax Credit (PTC) programs. In this paper, we consider path from conventional grid towards smart grid, challenges against integration of renewable energy, i.e. solar system. And impact of solar on grid stability, reliability of supply. Failure of grid which leads to total blackout which may lead to renewable energy as one of the solution to reduce impact of blackout- case study of total blackout in North India on 29th & 30th July 2012. The section of the paper will concentrate on Ways of assimilation of Solar system in Smart grid, challenges & benefits of integrated grid systems.

IV. CONCLUSION

In this paper, the key technologies of smart grid have been studied and reviewed. In this review several Smart grid technology can control renewable resources to effect changes in the grid's operating conditions and can provide additional benefits as distributed generation assets or when installed at the transmission level.

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