NOVEL INTEGRATED, DISTRIBUTED GENERATION APPROACH WITH RENEWABLE ENERGY INTERFACE WITH HVDC, A KEY SOLUTION TO THE FUTURE CHALLENGES

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ABSTRACT

The recent development in the integrated energy generation as well the distributed generation with the offshore wind farms provides good solution and an experienced significant growth to meet the load demand in recent years. Technical knowledge allow the design of wind farms at higher distances, making the high voltage dc (HVDC) transmission a real alternative to current high voltage ac (HVAC) transmission. When the network is decoupled from the wind farm by a dc link, there is no need for a mandatory use of three-phase generator. To the contrary, multi-phase generators can be used and the wind farm can benefit from inherent advantages and recent developments of multi-phase drives. This preliminary study shows some of the potential advantages of the dual three-phase generators in wind energy conversion systems (WECS). The idea of the WECS as well the Solar is inevitable as Limited fossil resources, the continuous increment in fuel prices and severe environmental problems require new sustainable electricity generation options, which utilize renewable energies. Wind energy, solar photovoltaic etc. The objectives of this paper is to develop an assessment methodology for renewable energy Wind /Solar electric generation and energy storage facilities integrated into electric power distribution systems with proposal with HVDC as the transmission system. the advantages of both the generation as well smart efficient transmission . The approach addresses the distributed benefits of electricity generation from renewable sources and their true value to the system, and to apply the methodology to the real time analysis.

Keywords: VSC- HVDC, Skin Effect, Wind farm, multi-phase.

INTRODUCTION

Since considering the advantages and the disadvantages of the available renewable energy resources, the Wind energy has become an issue of significant interest achieving a spectacular increase in the recent years. This is significant because of the technology improvements and due to ambitious Research Scientist objectives across the globe . The US as well European Union requirements regarding renewable energies have been recently tightened with mandatory goals, and the trend of increasing the installed wind power is going to be maintained in the next years. Among the whole expected wind energy growth, offshore is going to play a major role in new installations because of the benefits related to higher wind speeds, visual impact and land use. Offshore wind farms are nowadays planned to be installed in the open sea with distances of above 800 km to the transmission grid. The critical distance for the use of HVDC instead of HVAC transmission has been estimated to be between 600 and 800 km . Consequently, the use of voltage source converter high voltage dc (VSC-HVDC) transmission together with offshore WECS is becoming already an alternative to conventional HVAC considering th advantages and the disadvantages only for the distances of the transmission higher than 800 Kms . In fact, VSC-HVDC has been used by ABB to supply an oil and gas platform 65 km offshore in existing Bergen farm. The same company opens the possibility to use this technology for off-shore wind farms. HVDC is advantageous compared to HVAC because issues related to reactive power, harmonics and limited transmission length, have been suppressed with the technological developments in the recent years. This research paper also incorporates the recent terminologies as well the paper looks at Multi-Terminal Voltage Source Converter High Voltage Direct Current (MT-VSC-HVDC) technology as a means of distributing renewable electricity generation, ultimately providing a dependable, secure, resilient transmission network with redundancy and quality.

VSC-HVDC has already proven itself for transmission links over 800 km and more are being built. For MT-VSC-HVDC technology to be viable and proven within the offshore industry, it would have to face up to the already proven HVAC and VSC-HVDC links used today, like Germany's BorWin1 wind farm venture. Many papers have studied VSC-HVDC technology over HVAC in terms of its engineering and economics, but very little has been done in the way of MT-VSC-HVDC. This new transmission medium shall be reviewed in terms of its economics, viability and operational costs even though the break even distance is the criterion for the selection , considering the advantages this system provides the a simplified model. The final experimental analysis being conducted on fault analysis within a meshed VSC-HVDC network. Results obtained in this research paper definitely will ascertain the importance of MT-VSC-HVDC networks within the future of renewable energy networking, when compared with point-to-point HVDC/HVAC networks and when covering larger seas, since the point to point HVDC power transmission poses several problems, in this research paper , considering th future load demand as well the solution have been incorporated which provides the more stable, continuous power with minimum alleviation, and automatic contingencies with line loads.. The paper also incorporates the solution by the Integration of Renewable Energy Sources and Distributed Generation in Energy Supply Systems.

This paper deals with the Renewable Energy Sources and the development of distributed generation which necessitates the immediate provision of conditions for access and effective integration into the existing and evolving energy even with the complicated networks, as well since the preparation of the next generation of energy production and distribution infrastructure. Such an infrastructure will need to manage flexibly and effectively the supply of many thousands of small generators and a few hundred big ones to a huge and highly variable demand. The single Power Generator source and electricity markets need to respond rapidly to these increasing challenges in order to gain the full potential of the opportunities offered by new technologies. The constraints and obstacles are however not only technological, but include also normative and regulatory issues which require multidisciplinary action involving topographical, economic, financial aspects.

Three independent trends viz

- Utility industry restructuring
- Increasing use of RES,
- Technology advancements-

are laying the groundwork for the widespread introduction of cleaner technologies and decentralized generation. Through this development, more and more emphasis has to be given to aspects related to the systems technology for the integration into present energy networks. Integration of RES and distributed generation (DG) refer to the integrated or stand-alone use of small, modular energy conversion units close to the point of consumption. Integration of RES and DG differs fundamentally from the conventional model of central generation and delivery, in this approach; it can be located near end-users. Locating RES and DG downstream in the energy distribution network can provide benefits for customers and the energy.

Distribution system itself. By making use of waste heat close to the end user, the efficiency of the energy supply is significantly improved. In addition, distributed facilities can be operated remotely and used in a broad range of Customer-sited and grid-sited applications where central plants would prove

Impractical. Novel challenging efforts have been made for the development of new devices for the management of energy networks, integration of RES and DG in the distribution networks, systems for load management and shaping, as well as socio-economic aspects of decentralized energy markets.

Technologies bundled into the distributed generation system will increasingly include interfaces for connection to local supervisory control and data acquisition (SCADA), distributed control systems (DCS) and/or Internet/Intranet systems.

Other technologies that are necessary for a complete system include new approach as well developments in:

- Metering
- Protection and control
- Remote monitoring and fault diagnosis
- Automated (decentralized) dispatch and control
- Site optimization of electrical / thermal outputs.

This research paper also deals with the wind turbines which convert wind power to electrical power, with a rated generator power of marketable models currently ranging up to 2.5 MW. Hub-heights reach more than 100 meters, rotor diameters are typically 65 m for 1.5 MW machines. Rotor construction is either variable blade angle (pitch regulation) or non-variable, conversion from mechanical to electrical energy is via either synchronous or induction generators. Synchronous generators are usually equipped with pulse width modulated converters, control of these converters is essential for regulating the behavior of the windmill on the electric grid, e.g. reactive power adjustment. The technical availability of marketable systems has reached 98 to 99%, typical turnkey costs of wind power projects are around 900 to 1,100 EUR/kW. This paper also deals with the CHP which uses the fuels for the production of the Electricity as well the utilization of the heat produced during the process more efficiently which will reduce the primary fuel consumption by more than 30% consumption. This by default reduces the CO2 emission. by roughly 0.5 kg per kWh electricity produced This type of energy supply is especially useful for consumers with a continuous and steady-going heat demand.

Hybrid power systems usually consist of a conventional generator powered by a diesel or gas engine/turbine and a renewable energy source such as solar, wind, or hydroelectric. Batteries are often included in hybrid systems for a continuous power availability and/or more steady-going diesel operation. Eveln the solar power is utilized to maximum extent to nullify the effect of the increasing load demand, Telecommunications Network Provider Spending on Distributed Generation and Energy Storage Systems Is Expected to Total $31.1 Billion from 2015 to 2024 .A recent report from Navigant Research analyzes the global market opportunity for distributed generation (DG) and energy storage (ES) technologies in the telecommunications industry, provides the efficient load dispatch as well continuity in the power supply ..The PIER Program annually awards up to $62 million to conduct the most promising public interest energy research by partnering with RD&D organizations including individuals, businesses, utilities, and public or private research institutions.

This research paper bring and bridge the gap between the conventional and the renewable energy sources with the total integration and brings new energy services and products to the marketplace and creates state-wide environmental and economic benefits. Finally the funding efforts are focused on the following R&D program areas:

- Energy Innovations Small Grant
- Residential and Non-Residential Buildings End-Use Energy
- Industrial/Agricultural/Water End-Use Energy Efficiency
- Renewable Energy Technologies
- Environmentally-Preferred Advanced Generation
- Energy-Related Environmental Research
- Energy Systems Integration (formerly Strategic Energy Research).

The Paper finally explains the need of integration of renewable energy resources into the power grid , which is driven, largely, by environmental regulation aimed at promoting sustainable energy resources and reducing carbon emission resulting from energy use. Price and quantity controls of carbon emissions through taxation and cap and trade policies, along with renewable portfolio standards (RPS) are the primary drivers for massive penetration of renewable energy resources and for electrification of transportation. Both wind and solar photo voltaic are expected to comprise a significant portion of new power generation. However, the operating characteristics of these resources which are strongly influenced by weather patterns have a profound impact on the planning and operation of the power grid. Renewable energy production is uncertain as well diluted and cannot be forecasted accurately. Furthermore, it exhibit a highly variable diurnal pattern, hence integrating massive amounts of renewable energy resources into the power grid presents major challenges in terms of the dispatch, reserves, and ramping. The unpredictability of wind power supply which may change rapidly due to cold fronts and wind shifts can cause large deviations from hour-ahead dispatch schedules, as may a moving cloud cover affect supply from solar resources. Such uncertainty and variability exacerbates the need for spinning reserves, non-spinning reserves, regulation and flexible ramp resources in order to mitigate potentially adverse impact on system reliability. There is a need for research aimed at understanding and quantifying the impact that massive integration of wind and solar power will have on the power system in terms of efficiency, operational reliability, economic consequences and environmental outcomes. We also need to address the design and evaluation of technological and market based approaches to mitigation the adverse impact of such integration. Such analysis should be based on simulation models designed to explore and evaluate technological and market solutions that can facilitate the integration of renewable resources. Specifically, the potential of harnessing the inherent flexibility of certain load types such as heating, cooling and air conditioning (HVAC), PHEV charging and the deployment of distributed and system level storage devices to mitigate the variability and uncertainty of renewable resources. Specific research addressed in this trust area focuses on: Specifically to reduce the demerits of the HVAC, finally the transmission system to be chosen is the HVDC, which resolves the technical , financial burden on the current HVAC system.

The fig shows the Wind farm Energy output and its prediction to meet the load demand

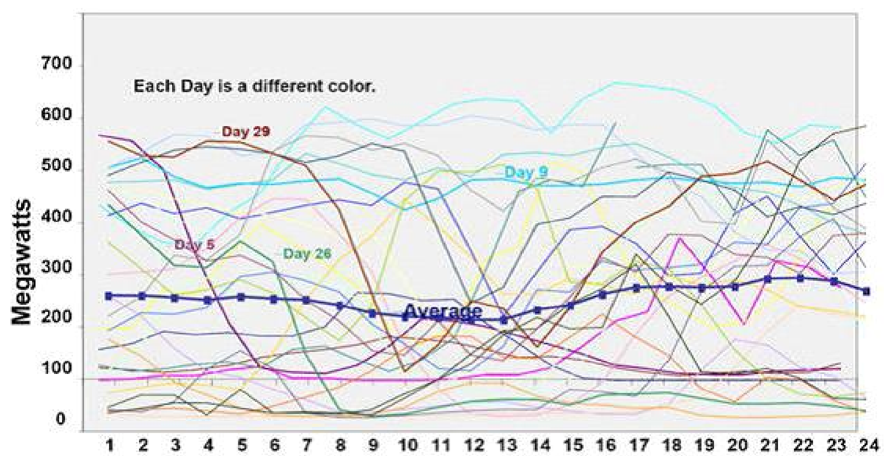

Fig. 1 Forecasting of the Wind energy generation with the duration of 24 hours

Supporting high levels of renewable penetration may degrade system reliability, and increase electricity costs or undermine the environmental objectives of the renewable, due to inefficient resource use. Averting such adverse consequences requires the harnessing of smart grid as well IT-based load control technologies that will enable mobilization of implicit storage capability embedded in flexible loads. Furthermore, new business models need to be developed for commercial entities that will aggregate flexible loads at the retail level to provide wholesale load response products that can meet or mitigate the increased need for reserves.

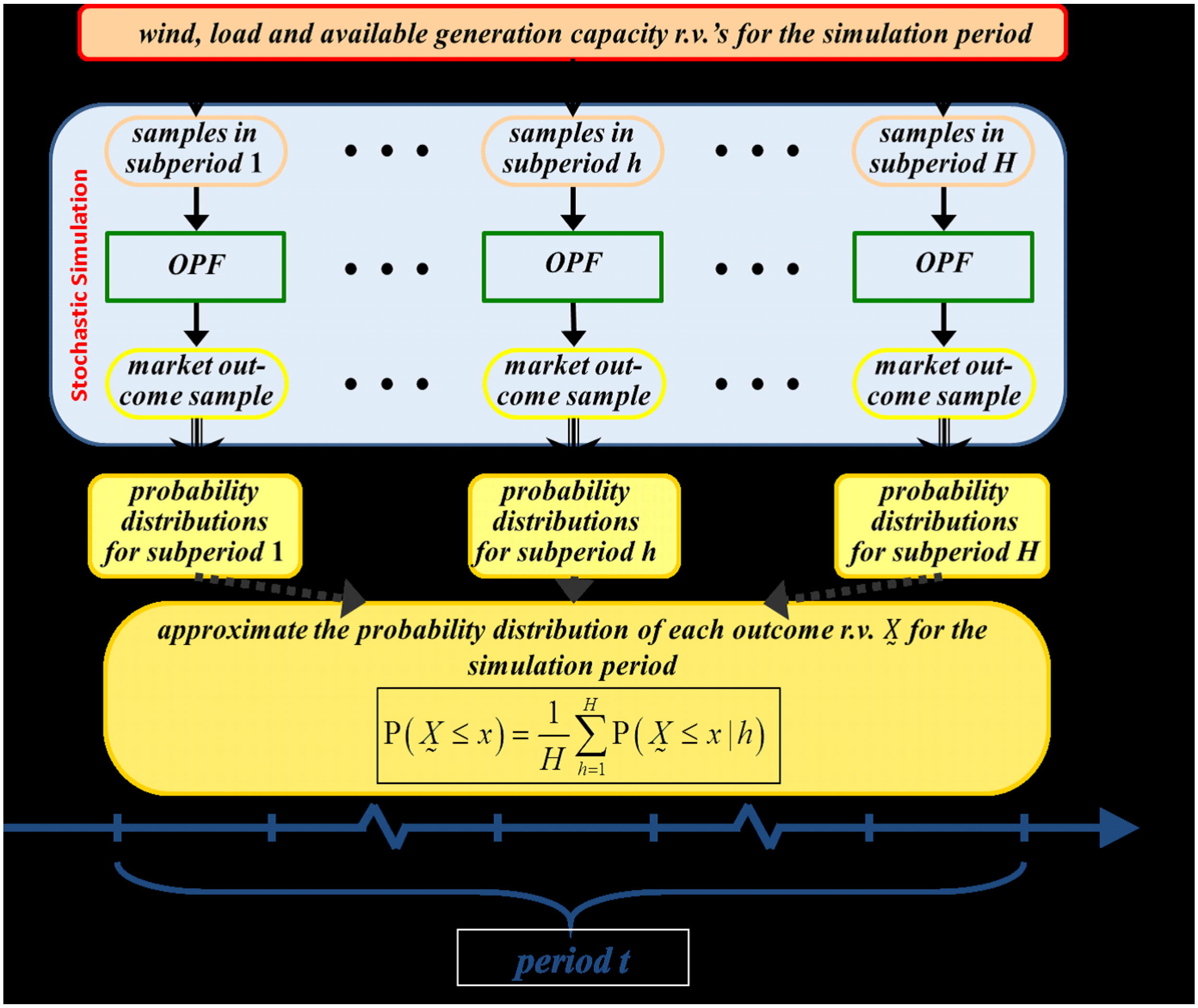

Figure 2. Basic Elements of the Stochastic Simulation

Since the recent Research encourages the wind farms with HVDC as an alternative to the HVAC, interest in offshore wind farms has experienced a significant growth in recent years. Technical knowledge allow the design of wind farms at higher distances, making the high voltage dc (HVDC) transmission a real alternative to current high voltage ac (HVAC) transmission. When the network is decoupled from the wind farm by a dc link, there is no need for a mandatory use of three-phase generator. To the contrary, multi-phase generators can be used and the wind farm can benefit from inherent advantages and recent developments of multi-phase drives. This preliminary study shows some of the potential advantages of the dual three-phase generators in wind energy conversion systems (WECS). The integrated power generation makes use of all the above aspects efficiently making the power delivery continuous smooth as well stabilized one.

CONCLUSION

This Research papers clearly explains and concludes that results presented is a novel control of an existing grid interfacing inverter to enhance the power quality at the load end. It has been shown that the grid-interfacing inverter can be successfully utilized for power conditioning without affecting its normal operation of real power transfer to the load circuit. The simulation results concludes that the grid connected Renewable energy sources such as the wind energy , the Solar etc, which can be used to send the real power from non-conventional source end to the grid and it also operate as active power filter with fast response, high accuracy of tracking the DC-voltage reference, which will provide the solution to modern increasing load demand as well the future load challenges, finally providing the continuous, stabilized, uninterrupted power supply irrespective of the load.

BIOGRAPHY

A. **Dr. Hadadi Sudheendra** is a senior professor in the Electrical engineering having vast experience in the renewable energy, BE., MTech, PhD working on the latest technologies viz smart grid, cyber security, Renewable energy and integrated power grids . A senior member of the IEEE, taught, trained several researchers in India and in abroad. Having around 20 years of teaching and Research experience.

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