

Sustainable Energy Management System Topologies and Control in Power System

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Abstract: As solar and wind energy is intermittent and unpredictable, greater penetration of their types into existing power systems can create and create high technical challenges, especially for weak grids or stand-alone systems without adequate storage capacity it's enough. By integrating the two renewable resources in an optimal combination, the effects of the different nature of solar and wind resources can be partially eliminated and the overall system becomes more reliable and economical. This document provides an overview of hybrid solar photoVoltaic wind systems, grid wind systems, energy quality issues, and energy quality in grid-based renewable energy sources.

Keywords: PV, wind, grid, solar system

I. INTRODUCTION

Centralized power generation has long dominated the electricity scenario. These systems use conventional energy resources to generate electricity. However, the global push to reduce dependence on fossil fuels and mitigate climate change has increased the pressure to change the paradigm of the current generation. Renewable power generation is becoming more popular and cheaper than traditional power generation systems to provide reliable power in areas that are not served by traditional power grids. Renewable energies are unpredictable and fluctuating in nature and generally produce little electricity compared to conventional generation [1]. Therefore, some means are needed to integrate more sources to provide more reliable and sustainable energy. The integration of different renewable energies forms a hybrid renewable energy system (HRES) that continuously supplies electricity to consumers as opposed to a single source system. Power converters are required for HRES sources for efficient and flexible connection of renewable energy sources to operate in stand-alone or grid-connected mode. However, HRES, which is unpredictable for PV and wind, cannot provide sufficient and stable electricity to meet the electricity demand. To ensure the dynamics of HRES, it is necessary to integrate several stable energy sources such as

batteries, fuel cells (FCs), supercapacitors or diesel generators into the HRES, especially in stand-alone mode and in the utility company. public in network-connected mode. In addition to its various advantages, HRES presents many technical challenges related to the quality of the system power, such as: B. Current fluctuations due to the presence of a new source or RES plug and play function, Voltage and frequency deviation caused by switching from the connected network to stand-alone mode and vice versa. Therefore, HRES must be able to alleviate power quality problems to provide high quality and more reliable continuous power. Power quality and system stability can be achieved with suitable control technology integrated into the control converter circuit. The biggest challenge, however, is to develop appropriate control strategies for HRES to address the aforementioned challenges.

II. LITERATURE REVIEW

Hamdy M. Sultan et al. [1] This article shows the effects of integrating high-penetration photoVoltaic (PVP) systems into the Egyptian national power grid. Load flow analysis is used to study network capacity when integrating desired PVPs and computer simulations are also used to evaluate transmission network upgrade to increase capacity. He also investigated how increasing the output power produced by PVPs under normal conditions affects the stability of the static Voltage. During temporary operating conditions (three-phase short circuit and failure of a large power plant), the influence of high levels of PVP penetration on Voltage and frequency stability has been demonstrated.

Ying Liu et al. [2] This article is aware of the rapid developments in new power generation and the influence of a large-scale hybrid wind / solar system on the transient Voltage stability of the power system. First, this document creates a complete hybrid wind / solar system model based on the Power Factory / Dig SILENT simulation software. An expanded control strategy is

suggested for the hybrid model by adding a damping adjuster on the rotor side of the DFIG. This strategy could effectively improve wind turbine failure management. Secondly, the effect of a large-scale wind / solar hybrid system on transient Voltage stability in different operating modes is analyzed.

A Arabali et al. [3] This paper proposes a stochastic structure for ideal measuring and dependability examination of a mixture power system, including inexhaustible assets and the energy stockpiling system. The vulnerabilities of wind, photoVoltaic (PV) and burden are demonstrated stochastically utilizing the autoregressive moving normal (ARMA). A model pursuit based improvement strategy is utilized related to Sequential Monte Carlo Simulation (SMCS) to limit system expenses and meet dependability prerequisites. The SMCS mimics the sequential conduct of the system and figures unwavering quality files from a progression of recreated tests. Burden move methodologies are proposed to give adaptability and diminish the inconsistency between sustainable power creation and ventilation and cooling loads in a cross breed impetus system.

S. Wang et al. [4] This article presents the four operating modes and 15 operating states of the hybrid wind / photoVoltaic propulsion system induced by the analysis of its energy flow and its operating characteristics as well as a coordination scenario. Power monitoring, control have been suggested charge monitoring, battery charge and discharge control and protected operation. Depending on the weather, load and battery conditions, the control scenario can successfully and automatically switch between different working modes or working states and implement the corresponding control strategies to ensure optimal and reliable system operation.

III. HYBRID SOLAR PV-WIND SYSTEMS

Solar photoVoltaic and hybrid wind plants are becoming a very interesting solution, especially for stand-alone applications. The combination of the two sources of sun and wind can improve reliability and your hybrid system becomes more economical because the weakness of one system can be complemented by the strength of the other. Integrating solar and hybrid wind farms into the grid can further improve the overall economy and reliability of renewable energy production to power the load. Likewise, integrating solar and hybrid wind energy into an autonomous system can reduce the amount of energy storage required for continuous power.

IV. GRID CONNECTED WIND ENERGY SYSTEM

The three main components for converting energy into WT are the rotor, gearbox and generator.

The rotor converts floating wind energy into mechanical energy and is thus the drive component of the conversion system. The block diagram of a wind turbine with a grid connection is shown in Fig. 1.

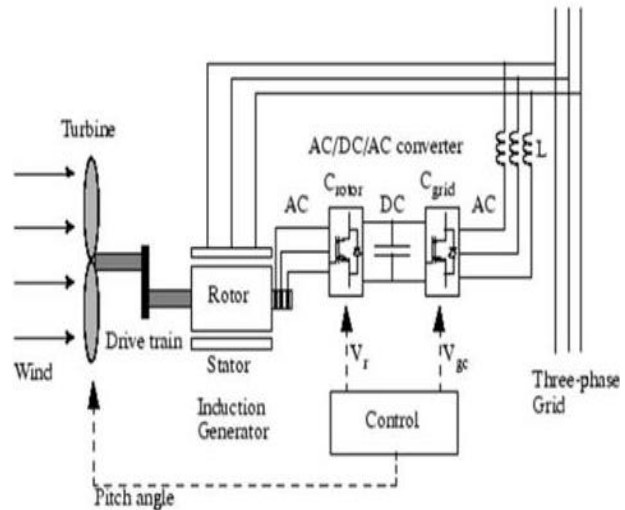


Fig. 1. Schematic diagram of Grid connected wind turbine.

In the common coupling point between the single WT or the wind farm of the grid, an automatic switch must be available to turn off the whole wind farm or the WT. Usually, this switch is located on the medium Voltage network in a substation where the electricity meter is also installed for billing purposes. The medium Voltage connection to the grid can be implemented as a radial or ring power supply, depending on the individual conditions of the existing power system.

V. POWER QUALITY

The intermittent energy of the sun and wind has a major impact on the safety of the loads, as these loads are not connected to the grid. A lack of power generation from these sources can prevent connected loads from receiving power. Voltage fluctuations, frequency fluctuations and harmonics are major power quality problems. The Voltage fluctuation due to changes in irradiation could make the PV system unstable, which affects the general reliability of the hybrid solar PV and autonomous wind system.

The same goes for fluctuations in wind speed, which affect the performance of the wind system and ultimately the whole hybrid system. Accurate forecasting and planning systems can minimize the consequences. The frequency stability of a generator must be considered counting on the load requirements and whether or not the generator is connected to AC loads with critical power frequency requirements. High frequency

fluctuations are often suppressed by using storage devices like a double layer electrolytic.

VI. POWER QUALITY PROBLEMS IN GRID CONNECTED RENEWABLE ENERGY SOURCES

Direct integration of wind and solar systems into the grid is associated with certain challenges. To connect renewable energy sources to the grid, we use grid integration: grid inverter. The use of inverters allows you to withdraw energy from the grid when renewable energy is insufficient. And provide energy when more electricity is produced. The connection from the grid to renewable energies and separation takes place in 100 ms the block diagram of the photoVoltaic generator connected to the grid is shown in Fig. 2, 3 show the wind turbine connected to the grid.

The main function of the converter in a grid system connected to a photoVoltaic generator is to correct the size and phase of the power of the photoVoltaic system using the feedback from the public grid. And in the case of a grid-connected to wind turbines, it acts as an insulator to mechanical and electrical frequencies.

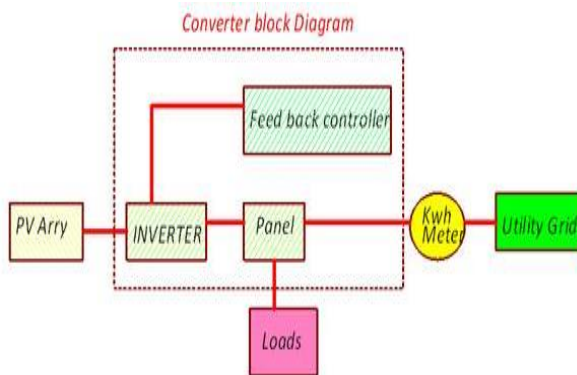


Fig. 2. Block Diagram for Grid connected PV Array.

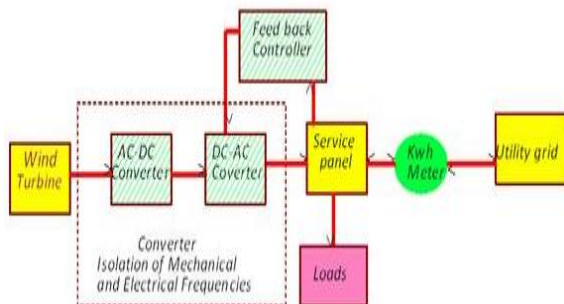


Fig. 3. Block Diagram for Grid connected Wind Turbine.

There are several technical problems associated with grid-connected systems, such as Problems with power quality, current

and Voltage fluctuations, memory, protection, and insulation problems.

VII. WIND ENERGY

The kinetic energy of the wind makes the wind turbine blades spin. This leads to a rotation of the generator shaft, which is connected to the rotor blades. The generator converts the mechanical energy of the rotating shaft into electrical energy. It is optional to connect the slow shaft of the rotor blades to the fast shaft of the generator with a reducer. In some cases, transfers are undesirable because they are expensive, bulky and heavy. A multipolar generator is an alternative option for a gearless system.

The power cord transmits electricity to a transformer. The transformer increases the low Voltages of the generator to the distribution or partial transmission level of the connected system Wind Turbine (WT) converts wind energy into mechanical energy. The power of a wind turbine can be expressed and the aerodynamic torque is given by:

$$P_w = 0.5 C_p \rho A V_w^3$$

$$T_w = \frac{P_w}{\omega_w}$$

Where P_w = Wind Turbine Power (in Watt)

ρ = Air Density (in Kg/m^3)

A = Rotor Area (in m^2)

V_w = Velocity of wind (in m/sec)

ω = Turbine rotor speed (in rad/sec)/

C_p = Power Co-efficient, It is the function of tip speed and blade pitch angle.

VIII. CONCLUSION

This paper provides an overview of solar photoVoltaic-wind hybrid systems, grid wind systems, energy quality problems, and energy quality in grid-based renewable energy sources. The effects of variability in solar and wind resources can be partially resolved in an optimal combination by integrating the two renewable resources. A hybrid power system based entirely on intermittent renewable energy sources creates an oscillating output Voltage that damages machines running on a stable power supply. The hybrid power system is the most advantageous power system required for the continued reliability of the power supply.

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