Renewable Energy Technologies for sustainable Development of Energy Effective Building

Dr. Yogesh Pahariya 1, Vaishali Devidas Nimbalkar 2

Head of Electrical Engineering (Power System) Department, Sandip University, Nashik

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Abstract - The purpose of this study is to identify the most relevant renewable energy technologies for buildings and to assess the effectiveness of their implementation. Methods of analogies and comparisons were used to determine the features of energy efficiency based on the technologies under study. The study proposes the methodological approach to assessing the effectiveness of the introduction of renewable energy technologies. This paper presents a comprehensive literature review on the reactive power management in renewable rich power grids. Reactive power requirements stipulated in different grid codes for REGs are summarized to assess their adequacy for future network requirements. Reactive power coordination between support devices and their optimal capacity are vital for an efficient and stable management of the power grid. The proposed model for assessing the level of energy saving provides an opportunity for economic justification of introducing renewable energy technology in buildings.

Key Words: *Renewable Energy, Power grid, Reactive Power, Devices, Buildings, Technology*

1. INTRODUCTION

Due to the global drive towards renewable and sustainable energy systems, power electronic converter (PEC) interfaced renewable energy generators (REGs), such as wind generators and solar-PV systems have widely been adopted in power networks around the world. The main goals of sustainable design were to reduce depletion of critical resources such as energy, water, and raw materials; prevent environmental degradation caused by facilities and infrastructure throughout their life cycle; and create built environments that are safe, productive and effective utility of the water and solar energy. A large part of these costs is related to providing a comfortable environment for a person to live or stay in a particular building. Maintaining a comfortable environment through improved energy efficiency in buildings is important not only to keep people safe and productive, but also to reduce carbon emissions by using renewable energy sources instead of fossil and carbonized ones. This study's limitation is the fact that the construction of a building using renewable technologies involves a complex integrated solution. Therefore, the technologies under study can be complementary in the context of meeting different energy needs. The study can help develop long-term strategies that take into account both energy and climate aspects in Kuwait in the context of the introduction of renewable energy technologies in buildings. The main premise for this is that implementing high-performance construction and renovation activities will require greater access to finance, as well as innovative business models that bring together borrowers, lenders and regulator.

1.2 LITERATURE SURVEY

1. Collins C. Ngwakwe "Role of energy efficiency on sustainable development" The main purpose of this current paper involves determining the role of energy efficiency on sustainable development. Thus, the paper adopts a conceptual approach by using current literature on energy efficiency in evaluating its purpose in sustainable growth. The paper finds that energy efficiency plays multiple roles towards sustainable economic development. The paper also introduces an additional approach that support energy efficiency termed "energy efficient strategy for urban residential setting sustainability" which further enhances sustainable growth.

2. Bader Alshuraiaan "Renewable Energy Technologies for Energy Efficient Buildings: The Case of Kuwait". The purpose of this study is to identify the most relevant renewable energy technologies for buildings and to assess the effectiveness of their implementation in the long term for Kuwait. Methods of analogies and comparisons were used to determine the features of energy efficiency based on the technologies under study. The study proposes the methodological approach to assessing the effectiveness of the introduction of renewable energy technologies, determining the direction of increasing the energy efficiency of buildings and the investment efficiency of introducing these technologies.

3. Mohammad nazmul islam Sarkar, lasantha gunaruwan meegahapola, "Reactive Power Management in Renewable Rich Power Grids: A Review of Grid-Codes, Renewable Generators, Support Devices, Control Strategies and Optimization Algorithms" This paper presents a comprehensive literature review on the reactive power management in renewable rich power grids. Reactive power requirements stipulated in different grid codes for REGs are summarized to assess their adequacy for future network requirements. The PEC-interfaced REGs are discussed with a special emphasis on their reactive power compensation

capability and control schemes. Along with REGs, conventional reactive power support devices (e.g., capacitor banks) and PEC-interfaced reactive power support devices (e.g., static synchronous compensators) play an indispensable role in the reactive power management of renewable rich power grids, and thus their reactive power control capabilities and limitations are thoroughly reviewed in this paper.

4. Arvind Chel, Geetanjali Kaushik "Renewable energy technologies for sustainable development of energy efficient building" The energy conservation through energy efficiency in the building has acquired prime importance all over the world. The four main aspects for energy efficiency in a building include first and foremost the nearly zero energy passive building design before actual construction, secondly the usage of low energy building materials during its construction, thirdly use of energy efficient equipment's for low operational energy requirement and lastly integration of renewable energy technologies for various applications. These aspects have been discussed along with their economics and environmental impacts briefly in this paper

1.3 BACKGROUND

This paper presents a critical review of reactive power management in renewable rich power grids, with special emphasis on grid-codes, renewable generator capabilities, reactive power support devices, control strategies, and coordination & optimization algorithms.

The reactive power capability and control schemes for various wind generator types, reactive power capability of solar-PV systems and other REGs are discussed in Section V, reactive power support devices. The proposed methodological approach to assessing the effectiveness of the introduction of technologies for the use of renewable energy sources allows one to take into account the drivers of energy saving, to determine the directions for improving the energy efficiency of buildings and to promote favorable investment support for the introduction of renewable energy technologies.

At the early stage of renewable energy integration, REGs could be either connected or disconnected from the power grid without significant impact on grid stability, due to their low penetration level.

2.1 PASSIVE BUILDING DESIGN

The most sustainable energy technique is to conserve energy as much as possible. Passive solar building design can aid energy conservation efforts because building design is directly related to energy use. Buildings with passive solar building designs naturally use the sun's energy for free of charge heating, cooling and delighting. This reduces the need to consume energy from other sources and provides a comfortable environment inside. The principles of passive solar design are compatible with diverse architectural styles and can be renovated with existing building for net zero energy use

2.2 PASSIVE SOLAR HEATING

The goal of all passive solar heating systems was to capture the sun's heat within the building's elements and release that heat during periods when the sun is not shining. At the same time that the building's elements (or materials) are absorbing heat for later use, solar heat is available for keeping the space comfortable (not overheated).

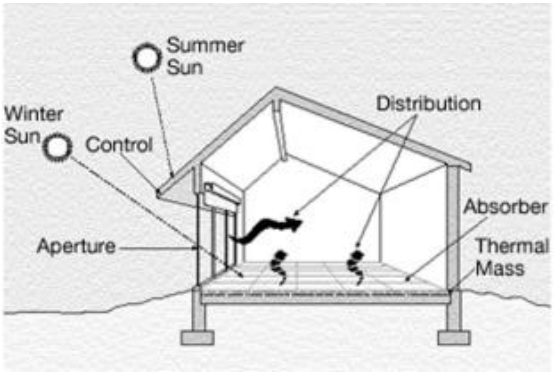


Fig 1: thermal mass absorbs heat in day through window and radiates in night

In indirect gain solar passive heating system, Trombe wall absorbs and stores heat during the day. Excess heat is carried out by passage air between wall and glass through thermosyphon principle into the interior space.

An indirect gain solar passive design that provides both heating and cooling is the thermal pond approach, which uses water encased in ultraviolet ray inhibiting plastic beds underlined with a dark color, that are placed on a roof. Hence, this system is known as roof pond solar passive heating/cooling system.

Fig 1.2: Trombe wall with air circulation open during day and closed in night

In colder climates, where heating is more desirable, attic ponds under pitched roof glazing are effective. Winter heating occurs when sunlight heats the water, which then radiates energy into the living space as well as absorbs heat within the water thermal mass for nighttime distribution

2.3 ADVANTAGES

- The supplementary controller reduces voltage
- The Proposed controller can effectively depend the oscillations of the wind farm after a ground fault
- The system was effective for reactive power support and the LVRT.
- Voltage variability and shirt term flicker severity has significantly reduced.
- Improves grid frequency deviation

2.4 METHODOLOGY

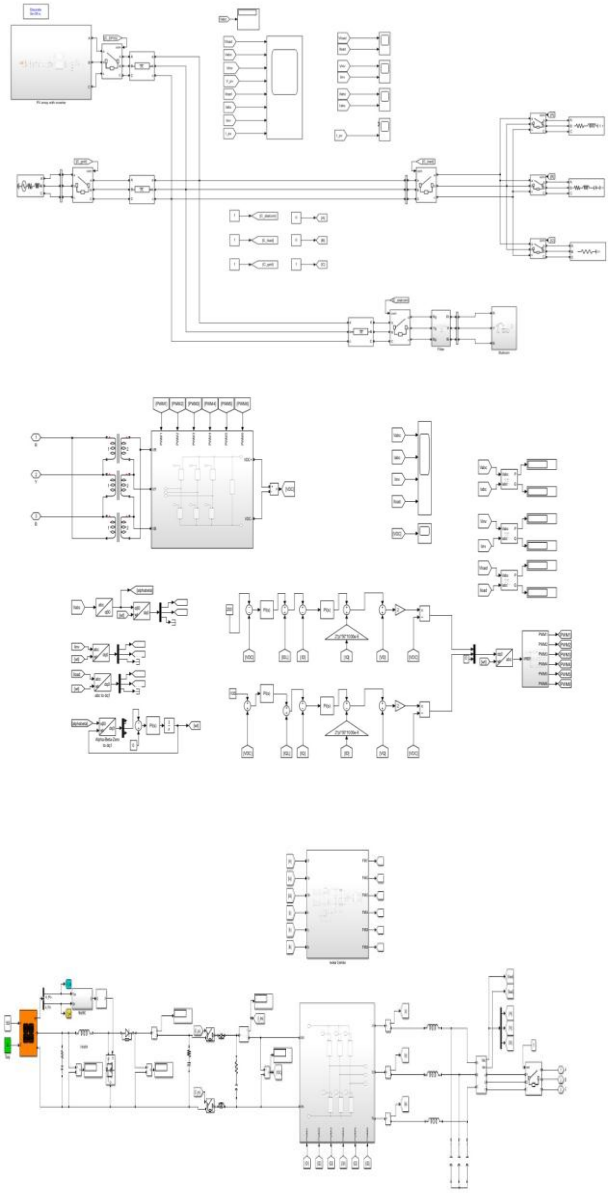
A New online supplementary learning control is developed based on the theory of approximate dynamic programming. A neural network based controller is develop based on ADP for reactive power support provided by GSC and DFIG Starter. Reactive power exchanged by the DFIG is optimally shared between the GSC and the RSC to reduce total converter apparent power appropriate control mechanism is developed to improve the voltage rise mitigation and voltage fluctuation reduction.

Vector control is used to inject reactive power into the grid during symmetrical grid faults. Virtual damping flux based LVRT control strategy can supress rotor current of the DFIG with a smooth electromagnetic torque.

3. CONCLUSIONS

A comprehensive review of recent literature reported on reactive power management in power grids with high penetration of REGs was presented in this paper. According to the review, many grid codes specify steady-state reactive power requirements for REGs, however only few grid-codes specify dynamic reactive power requirements. There are various methods to reduce the use of conventional energy from fossil fuels to meet the energy requirement for the building. The combination of various solar passive design aspects can easily be integrated in new buildings based on the site, orientation of building and local climatic conditions. The retrofit of Trombe wall as solar passive heating design concepts in honey storage building had shown promising results for winter heating. Similarly, the use of proper design of day lighting can lead to tremendous reduction in use of artificial lights during daytime and thereby reduces the energy consumption by building for lighting. Hence, integration of solar passive features into the building leads to reduction in energy consumption of building which ultimately reduces the CO2 emissions and helps in sustainable development.

2.5 SIMULATION IMAGES



2.6 OUTPUT IMAGES

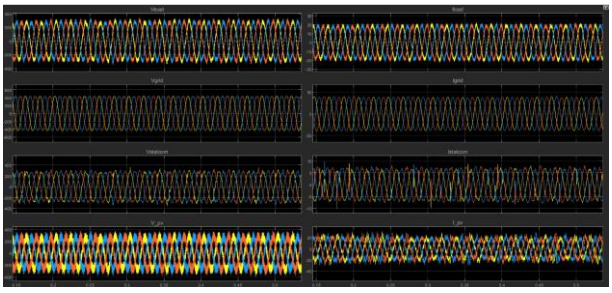


Fig 2: When PV, Statcom and grid is active

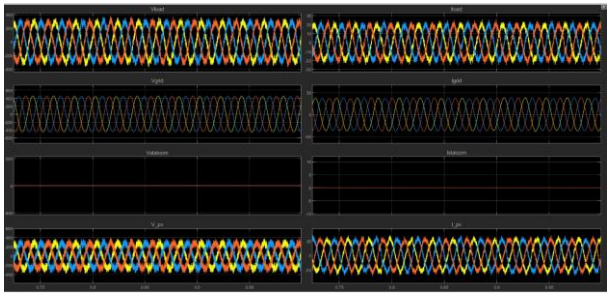


Fig 3: When Statcom is off, grid & PV is on

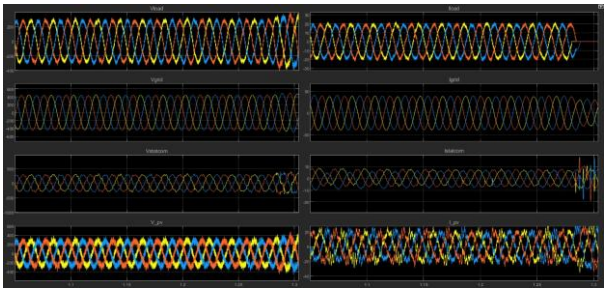


Fig 4: When load is OF

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