



e-ISSN: 2319-8753 | p-ISSN: 2347-6710

IJRSET

International Journal of Innovative Research in
SCIENCE | ENGINEERING | TECHNOLOGY

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 12, Issue 10, October 2023

ISSN INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA

Impact Factor: 8.423

9940 572 462

6381 907 438

ijirset@gmail.com

www.ijirset.com

Simulation of Energy Efficiency Optimization of Converter Based Renewable Energy Microgrid

T.KARTHI [1], T.RAJKUMAR, M.E.,[2]

PG Student, Dept. of EEE, The Kavary Engineering College, Mecheri, Tamilnadu, India

AP/EEE, Dept. of EEE, The Kavary Engineering College, Mecheri, Tamilnadu, India

ABSTRACT: Converter based renewable energy micro-grids have become an important part of the electrical grid. However, increasing risk resulting from many factors weakens the integration of the grid. This paper proposes a nonintegrated connection management system for network connection to improve the all-round resilience of network connection and prevent various risks. This plan will be used not only to increase energy but also to improve the quality of energy. A single control system is intended to manage unstable networks, heavy fluctuations and short circuit faults. System control is less dependent on system parameters. Additionally, a new calculations method is proposed to improve the performance in balanced and unbalanced situation. It can operate stably under normal and abnormal conditions (voltage imbalance, voltage drop, malfunction etc.). Performance based control was compared with performance based traditional control, and its superior performance was confirmed by simulation.

I. INTRODUCTION

Gridconnected photovoltaic (PV) systems have grown in the last few years due to global interest in renewable energy and increasing energy demand. Therefore, new control strategies have been developed to increase the efficiency, reliability and stability of gridconnected photovoltaic systems. The diversity of PV system components and control algorithms, together with the different types of scenarios and damage caused by failure, make testing PV systems very difficult, expensive and in many cases impossible. To eliminate all these risks and reduce the measurement cost, all PVconnected projects are modeled and simulated in various climates and networks. In order to ensure the safety and stability of the transmission line, all power companies around the world have issued strict regulations for transmission line electricity according to their terms. More and more photovoltaic gridconnected energy production is included in large projects, which brings with it new problems.

Due to increasing photovoltaic power generation systems connected to the power grid, if the photovoltaic power generation system fails to maintain the grid-connected state when a grid drop failure occurs, it will have a greater impact on the grid and aggravate the grid fault. Therefore, the study of unbalance control strategy of grid-connected inverters under grid fault conditions is of great significance to the development of photovoltaic grid-connected system and photovoltaic industry in our country, as well as the alleviation of China's energy crisis.

Grid voltage failure can be divided into steady-state small-value grid voltage unbalance and transient large-value grid voltage drop, including three-phase symmetrical drop and three-phase unsymmetrical drop.

Three-phase asymmetrical drop is usually caused by a single-phase ground short circuit, two-phase ground short circuit or short circuit fault between two phases. In the actual power system, unbalanced three-phase load of the power grid, large single-phase load capacity or asymmetrical faults in the power grid all cause the system to have voltage asymmetry. In the event of an asymmetrical grid voltage drop, the AC output current contains a negative sequence current. The existence of a negative sequence current can greatly damage.

The fluctuation of the second harmonic generated by the output power leads to a direct current side voltage fluctuation, which endangers the life and safety of DC capacitors. Negative sequence current suppression is generally achieved by adding a negative sequence voltage of the same magnitude and phase to the negative sequence current at the AC side; while an inverse of the product of the negative sequence voltage and the positive sequence current already

present in the grid Variables output port power twice the amount of fluctuations. Therefore, it is necessary to study the control method of PV grid-connected inverter to suppress the double fluctuation of grid negative sequence current and DC voltage during the asymmetrical drop of three-phase voltage.

[2] Proposes a decentralized power sharing method in order to eliminate the need for any communication between DGs or micro grids. The concept of the proposed power control strategy is validated for dissimilar operating conditions, by means of simulation in the MATLAB software environment. Microgrid concept widely for the better interconnection of DGs. Hybrid AC/DC micro grids have been planned for the improved interconnection of different distributed generation systems (DG) to the power grid, and exploiting the prominent features of both ac and dc micro grids. [3] Presents an overall description and typical distributed generation technology of a microgrid. It also adds a comprehensive study on energy storage devices, microgrid loads, interfaced distributed energy resources (DER), power electronic interface modules and the interconnection of multiple microgrids. [5] proposed an intelligent power management strategy for hybrid DC microgrid, including wind turbine, fuel cell and battery energy storage. The considered wind turbine has a permanent magnet synchronous generator (PMSG). In the considered structure, wind turbine operates as the main energy source while the fuel cell and battery bank are both auxiliary power sources. The main control objective is to supply the load power continuously while keeping all power sources in normal conditions. Hence, the fuel cell and battery bank are managed such that the system operates in normal condition and fuel cell will not generate excessive power. The proposed control scheme is based on the fuzzy algorithm.

II. PROPOSED WORK

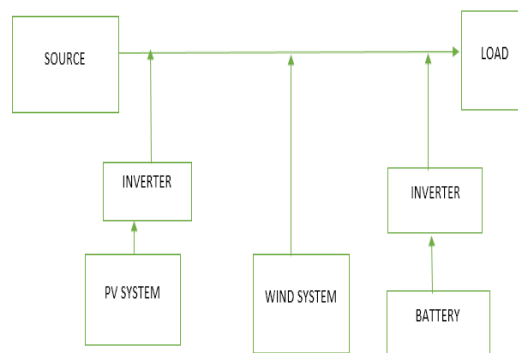


Fig 1: Proposed block diagram

A grid-connected hybrid AC/DC microgrid structure which consists of an ac microgrid on the left side, a dc microgrid on the right side, and the power exchange system on the middle side. In the ac microgrid, the photovoltaic power generation unit is connected to the ac bus through the DC/DC/AC converter to achieve the maximum power tracking (MPPT) and the unit power factor, but the ac loads is also directly connected to the ac bus. In the dc microgrid, the photovoltaic power generation unit through the boost converter to achieve MPPT, a battery as the storage through the bi-directional (buck-boost) DC/DC converter to achieve charge and discharge control, the fuel cells through the DC/DC converter to achieve constant power output, and variable dc load directly is connected to dc bus. The power exchange system consists of a bi-directional AC/DC converter which can operate in inverter or rectifier mode.

The rated voltages for dc and ac bus were 750V and 400V phase to phase rms respectively. The hybrid AC/DC microgrid connected with the utility grid by the point of common coupling (PCC), operating in a grid-connected mode.

PV system

PV cells are made of semiconductor materials, such as silicon. For solar cells, a thin semiconductor wafer is specially treated to form an electric field, positive on one side and negative on the other. When light energy strikes the solar cell, electrons are knocked loose from the atoms in the semiconductor material. If electrical conductors are attached to the positive and negative sides, forming an electrical circuit, the electrons can be captured in the form of an electric current that is, electricity. This electricity can then be used to power a load.

INVERTERS

Inverters are widely used in industrial applications. The applications are variable speed ac motor drives, induction heating, standby power supplies, and uninterruptible power supplies. The input may be a battery, fuel cell, solar cell, or other dc source. DC to AC converters is known as inverters. The function of an inverter is to change a dc input voltage to a symmetrical ac output voltage of desired magnitude and frequency. The output voltage could be fixed or variable at a fixed or variable frequency. A variable output voltage can be obtained by varying the input dc voltage and maintaining the gain of the inverter constant. Inverters can be broadly classified into two types:

- a. Single phase inverters
- b. Three phase inverters.

These inverters generally use PWM control signals for producing an ac output voltage.

An inverter is called a voltage fed inverter if the input voltage remains constant, a current fed inverter if the input current is maintained constant, and a variable dc linked inverter if the input voltage is controllable.

Wind energy conversion system:

A wind energy conversion system (WECS), or wind energy harvester is a machine that, powered by the energy of the wind, generates mechanical energy that can be used to directly power machinery (mill, pump) or to power an electrical generator for making electricity. The term can thus refer to windmills, wind pumps as well as wind turbines. The conversion of the energy of the wind into more useful forms can be done using a rotor fitted with blades or sails. Note that a suitable location needs to be chosen for the WECS, preferably an open area. Also, some general locations lend themselves far better than others for WECS. See Wind power.

For environmentalists, it is the best source of energy and one that promotes a clean environment. Wind is not known to have any substance that is toxic to the environment such as emissions of harmful gases. Another advantage of wind energy is the production cost, unlike oil and natural gas, the cost of producing wind power from wind energy is at an all time low. This low cost can be as a result of the few equipments that are required such as turbines and their maintenance cost is also low compared to a power generating station. Sometime in the future, wind energy might become the cheapest form of energy to produce.

Battery Operation

A voltaic cell for demonstration purposes. In this example the two half-cells are linked by a salt bridge separator that permits the transfer of ions.

Batteries convert chemical energy directly to electrical energy. A battery consists of some number of voltaic cells. Each cell consists of two half-cells connected in series by a conductive electrolyte containing anions and cations. One half-cell includes electrolyte and the negative electrode, the electrode to which anions (negatively charged ions) migrate; the other half-cell includes electrolyte and the positive electrode to which cations (positively charged ions) migrate. Redox reactions power the battery. Cations are reduced (electrons are added) at the cathode during charging, while anions are oxidized (electrons are removed) at the anode during charging. During discharge, the process is reversed.

Each half-cell has an electromotive force (or emf), determined by its ability to drive electric current from the interior to the exterior of the cell. The net emf of the cell is the difference between the emfs of its half-cells. Thus, if the electrodes have emfs \mathcal{E}_1 and \mathcal{E}_2 , then the net emf is $\mathcal{E}_2 - \mathcal{E}_1$; in other words, the net emf is the difference between the reduction potentials of the half-reactions.

The electrical driving force or ΔV_{bat} across the terminals of a cell is known as the terminal voltage (difference) and is measured in volts.

The terminal voltage of a cell that is neither charging nor discharging is called the open-circuit voltage and equals the emf of the cell.

Because of internal resistance, the terminal voltage of a cell that is discharging is smaller in magnitude than the open-circuit voltage and the terminal voltage of a cell that is charging exceeds the open-circuit voltage.

An ideal cell has negligible internal resistance, so it would maintain a constant terminal voltage of \mathcal{E} until exhausted, then dropping to zero. If such a cell maintained 1.5 volts and stored a charge of one coulomb then on complete discharge it would perform 1.5 joules of work. In actual cells, the internal resistance increases under discharge and the open circuit voltage also decreases under discharge.

DC to DC Converter

A DC to DC converter is an electronic circuit which converts a source of direct current (DC) from one voltage level to another. It is a class of power converter.

Electronic:

Linear:

Linear regulators can only output at lower voltages from the input. They are very inefficient when the voltage drop is large and the current is high as they dissipate heat equal to the product of the output current and the voltage drop; consequently they are not normally used for large-drop high-current applications.

The inefficiency wastes energy and requires higher-rated and consequently more expensive and larger components. The heat dissipated by high-power supplies is a problem in itself and it must be removed from the circuitry to prevent unacceptable temperature rises.

Switched-mode conversion:

Most AC-to-DC converters are designed to move power in only one direction, from the input to the output. However, all switching regulator topologies can be made bi-directional by replacing all diodes with independently controlled active rectification. A bi-directional converter can move power in either direction, which is useful in applications requiring regenerative braking.

Drawbacks of switching converters include complexity, electronic noise (EMI / RFI) and to some extent cost, although this has come down with advances in chip design.

PULSE WIDTH MODULATION TECHNIQUES

The best modulation techniques to maximize the boost, minimize the harmonic distortion, reduce the switches stress and reduce the number of device commutations in each switching period can be achieved by amalgamation of conventional switching concept along with selective shoot-through state. Figure shows vast classified impedance-source-network based electric power conversion system using different switching configuration. A combination of

various strategies with impedance source inverter provides extensive electric power conversion topologies from medium voltage/current to high voltage/current. Hence, utilizing this switching configuration for unidirectional/bidirectional, isolated/non-isolated converters can employ for any sort of converters (AC-AC), (DC-DC), inverter (DC-AC), and rectifier (AC-DC).

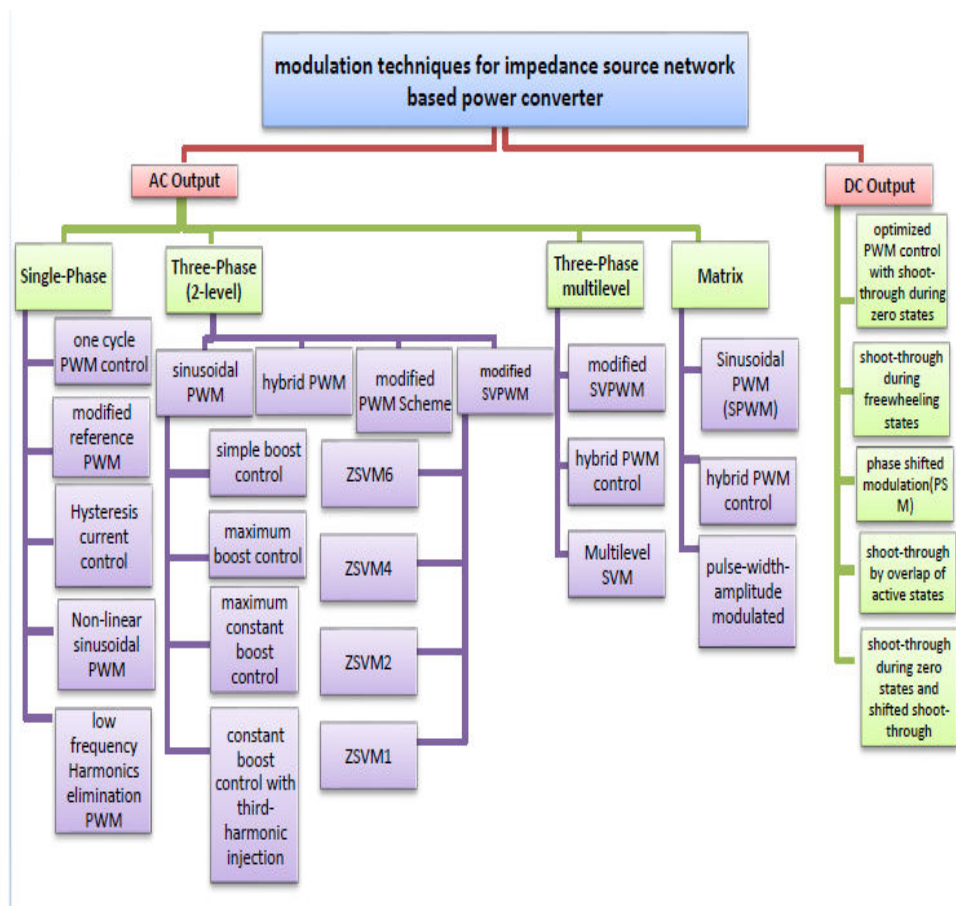


Fig 2 Categorization of modulation techniques for impedance-source network

In many industrial applications, to control of output voltage of inverters is often necessary to cope with the variations of dc input voltage, to change voltage of inverters and to satisfy the voltage and frequency control requirement of load. There are various techniques to vary the inverter output. The most efficient method of controlling the output voltage and frequency is to incorporate PWM control within the inverters. Different PWM techniques exist for this purpose.

III. SIMULATION RESULT

Proposed Hybrid Grid system

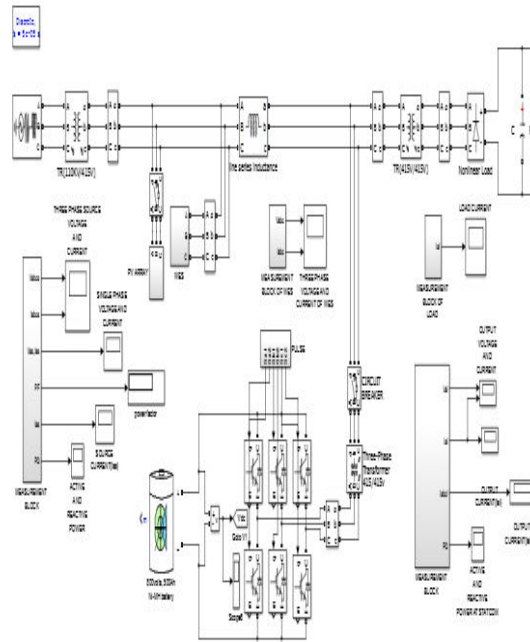


Fig 3 Hybrid grid system

PV SYSTEM

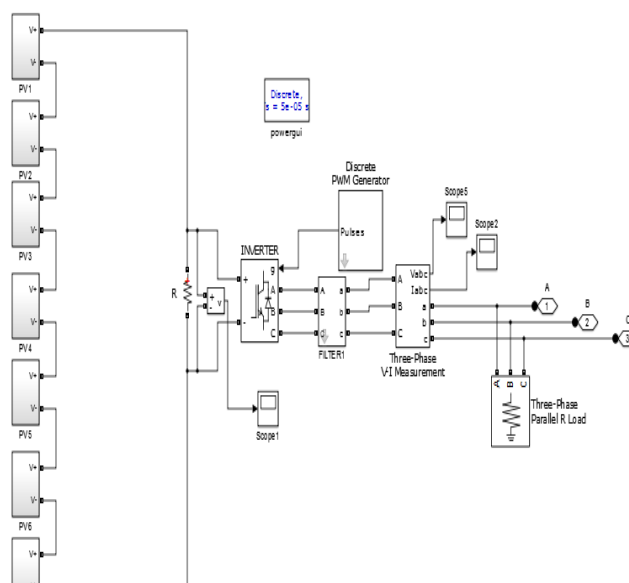


Fig 4 PV SYSTEM

WIND SYSTEM

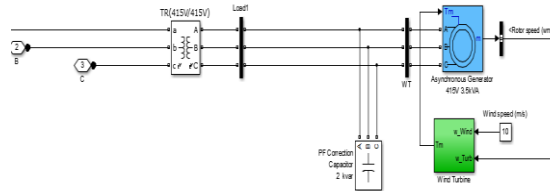


Fig 5 Wind energy system

Battery system

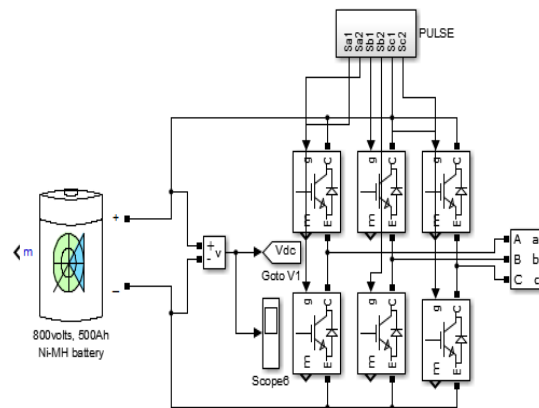
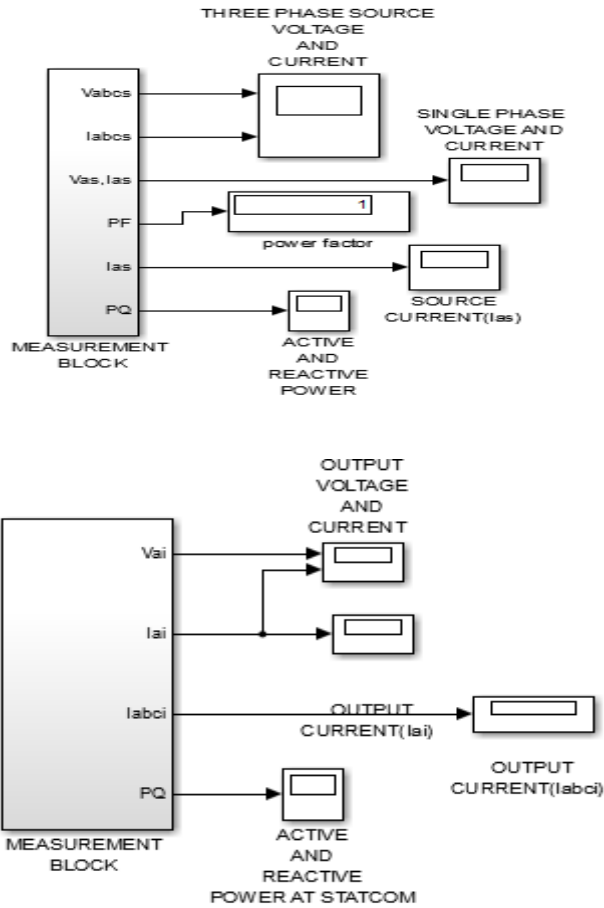


Fig 6 Battery system

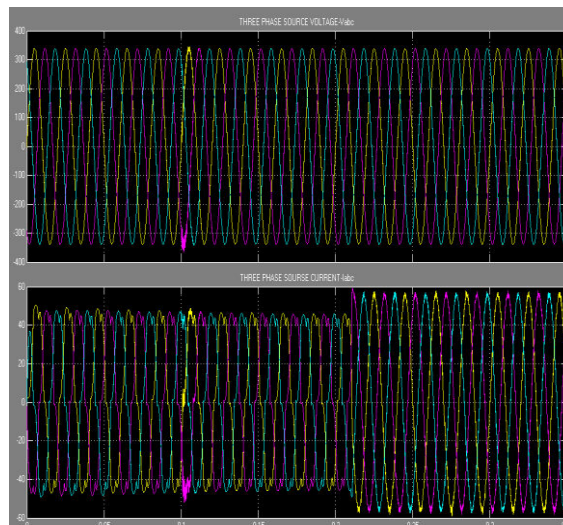
Pulse to Inverter



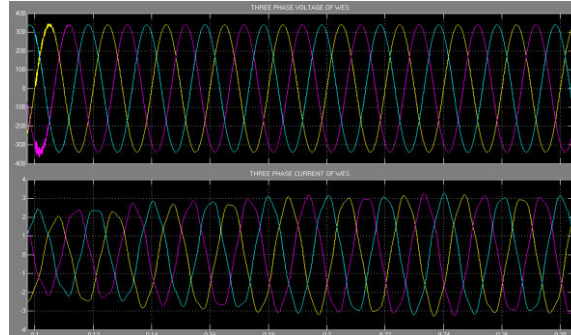
Measurement block



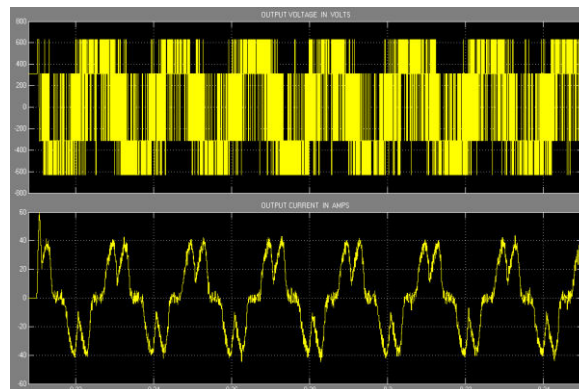
Grid Voltage and current



WECS Voltage and current



Grid connected output



IV. CONCLUSION

The project is about a decentralized control strategy based on the two stage modified droop method in dc and ac micro grids. This hybrid micro grid architecture prepares an infrastructure for flexible connection of different ac or dc loads and sources to the grid. This project is designed to the decentralization control of virtual impedance concept for autonomous power management of a ac/dc micro grid. The concept of decentralization control to enable the tie breaker based only on the information extracted from the micro grid. The hybrid grid connected system is simulated using MATLAB. The hardware implementation with hybrid PWM is scheduled in the next phase.

REFERENCES

1. Hajjzadeh, Amin; N. Soltani, Mohsen “Intelligent Power Control of DC Microgrid” In Proceedings of 2017 IEEE 17th International Conference on Ubiquitous Wireless Broadband (ICUWB) IEEE Press
2. S.Rohini, T.Sasikumar “Power Control And Management In A Hybrid Ac/Dc Microgrid Using Decentralization Control System ” International Journal of Innovative Research in Technology, Science & Engineering (IJIRTSE) 2395-5619, Volume – 2, Issue – 1. January 2016
3. Farzam Nejabatkhah, Yun Wei Li “Overview of Power Management Strategies of Hybrid AC/DC Microgrid” IEEE Transactions on Power Electronics 2014
4. Eklas Hossain, Ersan Kabalci “A Comprehensive Study on Microgrid Technology” International Journal Of Renewable Energy Research Ramazan Bayindir et al. ,Vol. 4, No. 4, 2014
5. Poh Chiang Loh, Ding Li, and Yi Kang Chai “Autonomous Control of Interlinking Converter with Energy Storage in Hybrid AC-DC Microgrid” 2013 IEEE
6. F. Katiraei, M. R. Iravani, A. L. Dimes, and N. D. Hatziargyriou, —Micro grids management: control and operation aspects of micro grids,| IEEE Power Energy Mag., vol. 6, no. 3, pp. 54–65, May/Jun.2008.



INNO SPACE
SJIF Scientific Journal Impact Factor
Impact Factor: 8.423



ISSN INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA



INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

9940 572 462 **6381 907 438** **ijirset@gmail.com**



www.ijirset.com

Scan to save the contact details