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A Review on Microgrid for Educational Intuitions-Challenges

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Abstract: The future electricity sources in India must be green energy, flexible, accessible and sustainable. The Educational Institutions are a back bone of any country, which are planning major role in development of nation. In India maximum Educational Institutions have only day scholars and maximum electrical energy demand in Institutions between 9.00 AM to 4.00PM. The government of India introduce many programs for green campus development across the country, under this program solar power plant will be setup for fulfil the electrical demand in day time. The educational institution will implement the Microgrid in ON-Grid mode for fulfil the electrical demand from solar PV Power Plant. In this paper we are studying the major challenges for microgrid implementation in Educational Institutions in India.
Keywords: Microgrid, Educational Institutions, PV, ON-Grid, Demand Management

I. INTRODUCTION

Microgrid is a transformative solution to meet energy demand in future. All the countries in the world have main concern about environmental pollution from conventional sources, which is main cause of global warming. The government of India is also promoting green sources and clean energy to fulfil the electrical demand under many programs or schemes. Under same path for implementation of Micro grid with PV to fulfil the demand government introduces many benefits to the consumers. PV based Microgrid is considered as one of the most auspicious solutions to fulfil the electricity demand in ON-Grid or OFF-Grid mode*[1,2]*.In any country, Educational Institutions are back bone and play major role in the development of the country. The Indian Government introduces different programs for implementation of PV Microgrid on roof tops of the educational Intuitions to fulfil the electricity demand as shown in Figure-1. Under same program across the country many Educational intuitions have come forward to set up the PV Microgrid in ON-Grid mode for their electricity demand*[1]*.

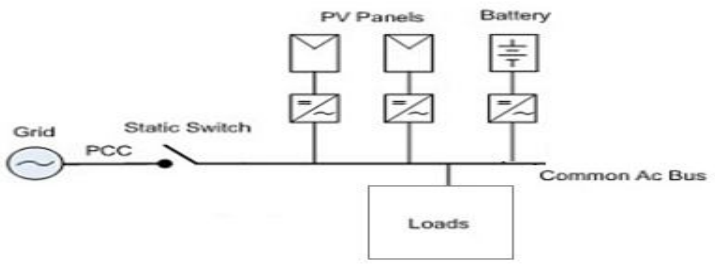

Figure-1 A PV Microgrid for Eductional Institutions

The PV Microgrid is a transformative solution to meet energy demands in Educational Intuitions, and its consists of load and distributed generators in same cluster, which are operating as a single controllable Unit. The PV Microgrid Improve the reliability and efficiency of Local distribution system, bringing environmental and economic benefits. At same time there are few challenges PV microgrid like improvement of Demand Management, Power Quality, active and reactive power flow control and fault ride through etc. In this paper we are reviewing in detail the Technical challenges like Power management and Power Quality of PV Microgrid in Educational Intuitions. In Section-II Demand Management of PV Microgrid, Section -III Power Quality In PV microgrid Section-IV Proposed Solution and Finally we concluding the paper.

II. DEMAND MANAGEMENT OFPV MICROGRID

The Demand management of solar PV microgrid has gained more attention in past few years. As the load in Educational Institutions are not constant all the time and during peak hour's demand is higher than generation. So, in peak hours demand in Educational Institutions PV Microgrid access extra power from main grid and in off-peak hours feed the access energy to Main grid. In any case if main grid is fail the PV Microgrid integrate with DG for extra load demand as well as PV microgrid required reference voltage and frequency to start the generation from solar PV power plant. In Solar PV Microgrid Power will flow in both the directions from Main

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grid or DG to load as well as from PV Plant to Main grid based on load demand in Educational Intuitions. Due to instability in generation from solar power plant the synchronization with main grid to excess the extra power in peak load demand and reverse power flow from PV grid in off peak demand, is causing of instability in Microgrid as well as in Main grid *[1]*.The injection of current control in PV Microgrid is based on direct control method, which is cause of current injection effecting the performance of PV Microgrid and its presenting current sources. Due to lack of voltage & current and frequency control in PV Microgrid it cannot operate in island mode *[3]*. In Educational Institutions have sophisticated and sensitive loads based on semiconductor and modern digital appliances, which are main cause of instability and poor reliability in PV microgrid *[5]*.The Demand management system improves the stability of the PV Microgrid, by synchronize the loads and source in Educational intuitions. The strategies and control of Demand Management is based on real time operating system for voltage control and current control in PV Microgrid*[4]*. The renewable energy source, such as a solar wind source, cannot operate standalone for satisfactorily within the operating limits and meet the load demand in Educational Intuitions due to its intermittent nature. Some additional sources and sinks are required to integrate the various sources in Microgrid to counterbalance the fluctuating nature of the solar. With fast development in renewable energy and Power electronics technology, cost reduction in energy storage and wider applications of the microgrid system, different control strategies and Demand management systems have been proposed for solar integration *[6][1]*.

III. POWER QUALITY IN PV MICROGRID

Due to use of excessive non-linear and unbalanced loads in Educational Institutions, the Power quality gain more attention for PV Microgrid. The instability in loads are causing over-stress on distribution network and casing the failure of PV microgrid.Due to power quality problems a wide range of disturbance like harmonic distortion, voltage sags/swells and interruptions are occurring in microgrid *[1]*. Voltage sag can cause fail or shut down effect on the sensitive equipment's and it's creating a unbalance in current, which will casing trip of circuit breakers. The effect of voltage Sag on performance of PV Microgrid, which is connected to Main connected through local distribution network. The voltage sag causes the reduction of power quality and increase the current harmonic distortion *[7]*. As the generation of PV Microgrid is depends on atmospheric conditions and load demand. As the atmospheric conditions are not constant all the time, due to instability in wavelength and radiations the generation of PV Microgrid is not constant all the time. For improving the operating efficiency of PV Microgrid, efficient control scheme is required to deliver the maximum power from PV Microgrid in Educational Intuitions to fulfill the electrical demand. The implementation of controlling method for PV Microgrid in grid connected mode to improve the stability generation under disturbances such as changes in atmospheric conditions, change in load and due to faults, which will cause the poor power quality *[8]*. The poor power quality casing a wide range of disturbance like harmonic distortion, voltage sags/swells and interruptions are occurring in PV microgrid. The Voltage sag can cause fail or shut down effect on the sensitive equipment's and it's cause a unbalance in current, which will trip the circuit breakers*[9]*. The main grid, in case of PV Microgrid large and sudden changes in load may results voltage transient with large magnitudes in ac bus. The non-linear loads and switching power converters are decreasing the power quality in PV Microgrid *[10][1]*.

IV. SOLUTION FOR DEMAND MANAGEMENT AND POWER QUALITY

To achieve high stability and reliability of PV microgrid in Educational Intuitions be need to design the Demand management system for synchronize the loads in PV Microgrid and Main grid or DG. The Smart grid is providing flexible energy demand according to load demand in intuitions. It's helping to segregate the sensitive load and normal load in Educational Intuitions and providing high priority for sensitive loads, when main grid is outage. The real time Demand management system will provide reliability of PV microgrid in Educational Intuitions *[11][1]*. For improving the power quality in PV microgrid, there are mainly different approaches in Educational Intuitions. The first approach is Intuitions side or from utility side based on the load conditions; this approach is called load conditioning. In this case we will ensure that load equipment is less sensitive to power disturbances, and they are operating even under significant voltage distortion also. The second approach is based on external equipment installation near the load or source for improving the power quality. The installation of equipments is line conditioning systems that suppress or counteracts power system disturbances. Some of effective and economic measures can be identified as following for power quality improvement in Smart village *[1, 11,12,13]*.

A. Installation Lightening and Surge Arresters with PV grid
B. Connect the Thyristor Based Static Switches at load side and sources side.
C. Energy Storage Systems for PV grid
D. FACTS devices

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V. CONCLUSION

We review the major challenges and solutions of Demand management and power quality in PV microgrid for Educational Intuitions. From different reviews, we understand the reliability and instability problem is occurring due the atmospheric conditions for PV Microgrid for Educational Intuitions. To improve the reliability and stability of PV microgrid the Demand management is required. On other side, Educational Intuitions have non linear loads and PV Microgrid operating with power electronics devices for energy convection the power quality problem is occurring, which is cause of poor stability and reliability of PV Microgrid. As name indicates the real time or Smart control based on FACTS and ANN are implemented for improving reliability, power quality and stability of PV microgrid in Educational Intuitions to achieve the high stability and reliability.

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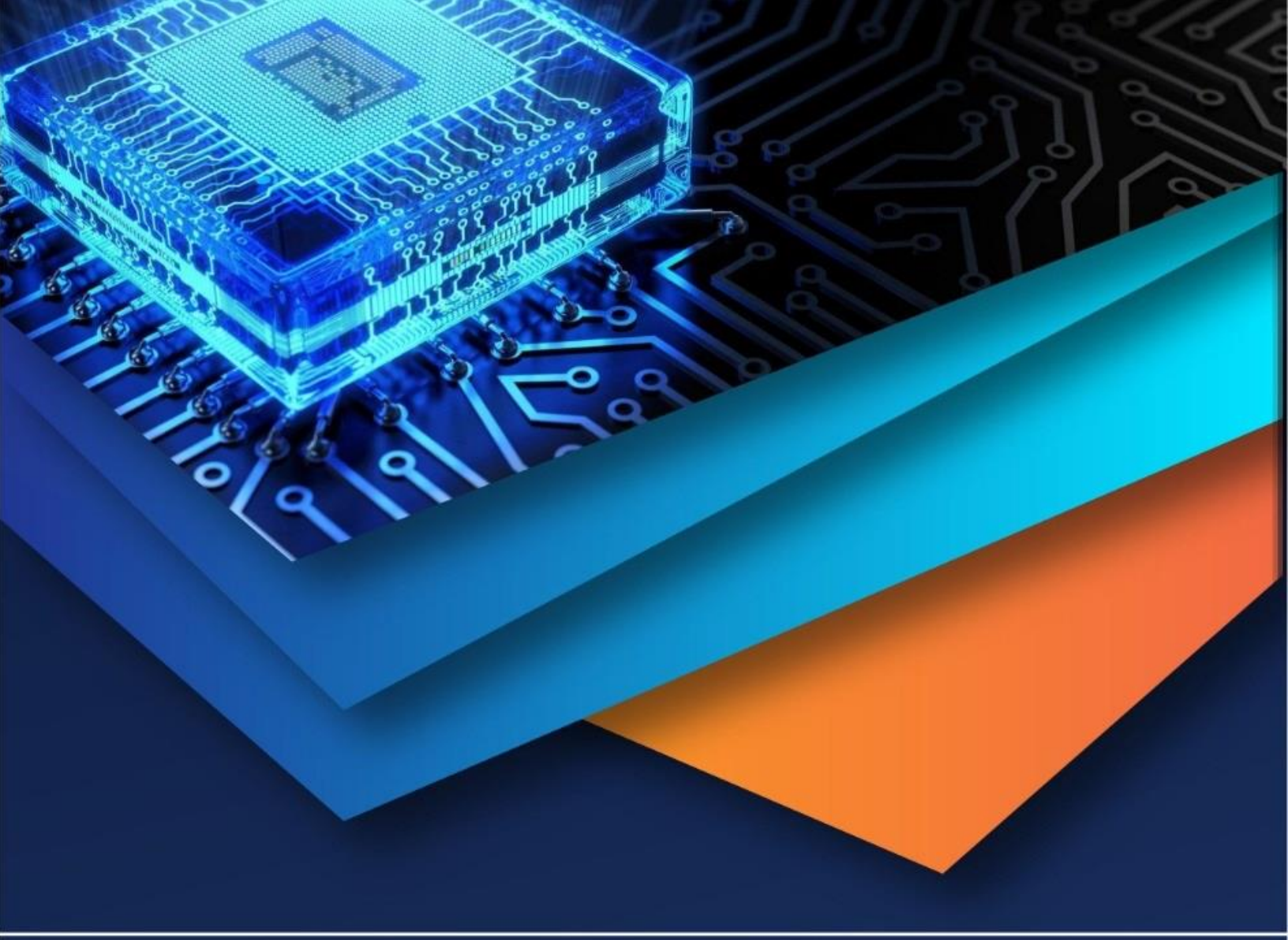

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