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Distributed Energy Storage Devices for Grids

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Abstract: Distributed energy storage (DES) is the device connected to the grid that is meant for electricity storage and is called distributed energy resources (DER). Within a smart grid, the DER system can be coordinated and managed by interfacing devices. Thermal plants, nuclear plants, hydroelectric plants, and large-scale solar plants are generally classified as centralized plants and need electricity to transmit to load centres, but DER systems are localized, flexible, decentralized and do not need electricity to transmit to longer distances because it is located close to the heap habitats to serve. The capacity of the DER system is maximum up to 10 MW. DER system generally has many generation and energy storage devices in this way it is also called a hybrid power system. Distributed energy resource systems are an alternative or an enhancement of conventional power systems. Initial capital cost per kW is generally higher in a hybrid power system. Microgrids are small-scale grids, modern and localized in contrast to conventional power stations. There are several microgrids that are connected to the central grid and may be disconnected. It operates in islanded mode and reduces central grid instability issues. Microgrids are generally introduced by the local area to which it has to serve and this is usually a low voltage ac grid. Diesel generators are often used by microgrids. By integrating several distributed power generators together, the insurance and control of a microgrid become a challenge.
Keywords: Microgrid, Distributed energy storage (DES), Distributed energy resources (DER), Conventional, Islanded

I. INTRODUCTION

Microgrid has an important feature of providing several needs of end-users like cooling, heating, and electric power as well because it permits energy carrier substitute. Hence the effectiveness increases because of the utilization of unwanted for heating and cooling. A microgrid is capable of handling the transition period between grids connected mode and islanded mode. Figure1.1 Depicts the schematic representation of the distributed power generation. Additional services may be offered by the activities of trade among a central grid and a microgrid. In the standalone mode and actual and reactive power produced among the microgrid must be equivalent to the demand of local loads.

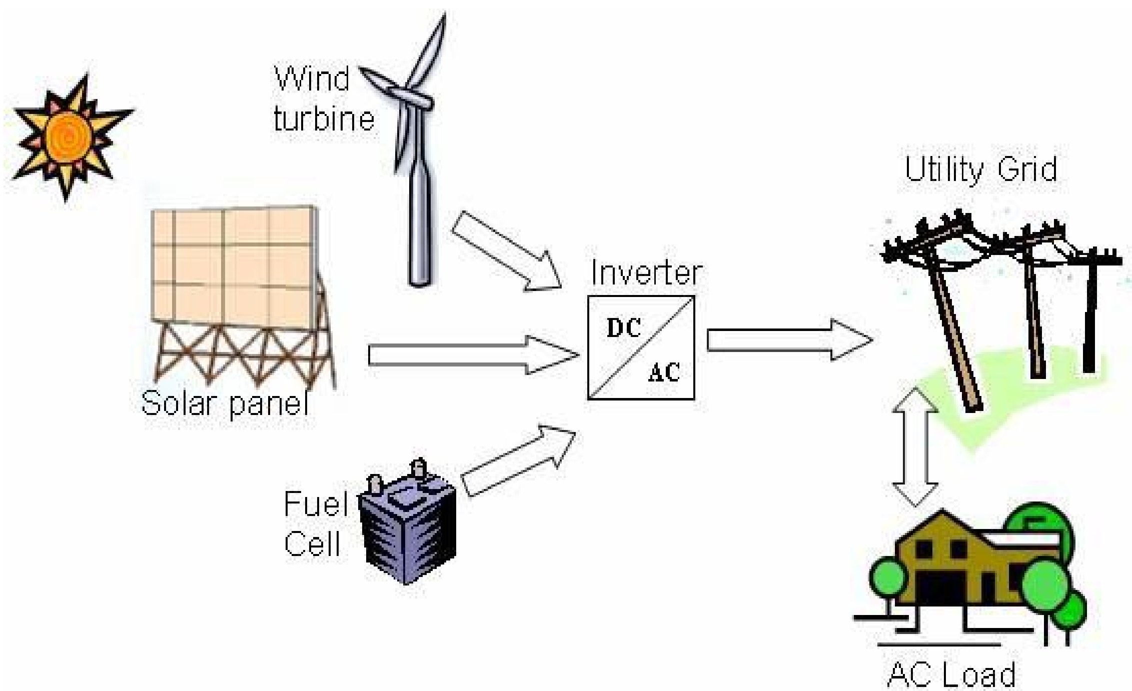

Figure 1.1 Schematic diagram of a distributed power generation

II. MICROGRID

A microgrid generally has a distributed generation (DG) unit, energy storage system and loads.AC microgrids were introduced first because existing electrical grids are primarily AC systems. The little bit of a current AC network, like a private local area, can be changed over to an AC miniature matrix through the establishment of adequate DG alongside a detaching switch at the framework interface for islanding purposes. A DC miniature matrix is more reasonable for new region advancement establishments in rustic regions, private structures, or business offices. However, the concept of DC microgrids may be applicable for current installations since the current AC system is principally a system that has three-phase having at least three wires that are the number of wires required for a DC system: negative, positive, and ground. Nevertheless, converting an existing system to a DC microgrid would require an impressive measure of gear retrofitting just as force electronic converters establishments. One of the significant elements in a choice to utilize AC or DC miniature lattices is the quantity of converters needed in the framework, which is reliant upon the sort of DG that is utilized and the framework loads associated. Supplying motors with volatile speed drives, LED loads, DG lighting, and UPS frameworks from AC frameworks requires many conversions that lead to energy loss. Environmentally friendly power sources are that sources which are regenerative or give energy to all inconclusive viable reason. This incorporates sun-powered, geothermal, wind, tsunami, hydropower, and biomass.

III.LITERATURE REVIEW

The energy demand is sharply increased due to industrialization, huge population growth, and increased comfort lives, etc. This energy demand mostly extracts from hydrocarbon fuel like petroleum, coal, or natural gas that is unsustainable. The known reservoirs are expected to be finished in near future. The whole world may face an energy crisis soon, altogether the fossil fuel produces greenhouse gasses (GHG) which causes the climate change. This is hindering for the nations whose economy generally inclines toward the per capita utilization of energy. That's why it is highly required to exploit the renewable energy sources (RES) and generate power at its maximum limit to strive for a faster increase in demand for electrical energy. Moreover, the worldly scenario of economic and constitutional conditions suggests that developing countries like India which has a vast resource of renewable energy must develop their renewable energy resources technologies. The renewable energy resources include solar photovoltaic, geothermal, tidal, wind energy, hydroelectricity, fuel cell, and biomass, these resources have vast scope for power generation in India. Out of these energy assets, sun based photovoltaic innovation is extremely valuable particularly for far off zones, where it is costly to have framework lines. For many solar applications, it is necessary to estimate the energy input data from available meteorological data. Therefore, an extensive literature survey has been carried out and a list of research papers that have been studied is given at the end of the thesis. The data collected from the different roof-mounted solar power plants and the plants containing different solar cell technology have been used in this research work. Lutero Carmo de Lima et al. have done the performance investigation of a system of solar PV which is installed in Brazil in the State University of Ceara. The PV system was investigated for one year. During the period of investigation, the yearly energy output, the references based on the daily average, arrays, last output has been found relatively good for the north eastern region of Brazil. The performance ratio and capacity factors were also measured and found 82.9% and 19.2% correspondingly. Aslan Gholami et al. [2] have developed an experimental setup for 70 days to identify the blow of and amassing on the performance of the photovoltaic system in Tehran, Iran. This investigation showed that without rain too much dust was accumulated at the PV array's surface which reduces power generation significantly. This reduction in power generation arises due to dust accumulation was such that three hectares of forest would be required for absorbing carbon.

IV.METHODOLOGY

The force age and productivity of the plant depend on the ambient temperature, global irradiance, and soiling loss. The goal of this work is to notice the presence of the PV system with respect to global irradiance, average temperature, and time of hour (TOH) for 24 hours. The exhibitions of SPV as for various climatic boundaries and topographical conditions have been accounted for in numerous specialized papers. When contrasted with translucent cells, the dainty film sun-powered cells were more adaptable. The solar cells made of polycrystalline silicon with an epoxy surface, monocrystalline silicon with a glass surface, an amorphous silicon panel with glass were examined in the dry climatic condition in India under dust accumulation. Researchers performed the test for nearly 1.1 hours and found that the decline in performance in the amorphous module a less and larger decline in polycrystalline. Various investigations have been done to evaluate factors that impact PV execution; dust testimony or ruining is the most effective factor. It is clear that any alteration in the power of irradiance or quality, changes the exhibition of PV yield; subsequently at whatever point residue of natural or nonorganic in nature kept on the outside of the module, changes the solar irradiance characteristics incident on PV module.

The cleaning frequency and the method of cleaning are highly sited specific. One study strongly advised that cleaning must be done within 2-3 weeks in the absence of cleansing rain. It was suggested that a cost/benefit analysis be conducted for any system to conclude its specific needs in terms of a cleaning schedule

The effect of various climatic components like irradiance, surrounding temperature, dampness, downpour, and so forth have been concentrated by re-enacting a matrix-associated sunlight-based PV framework. The incorporated re-enactment climate language (INSEL) programming has been utilized to mimic the model and study. In a moderate climate, the average performance ratio of new PV installations has improved from 0.65 to 0.85 over the last 20 years of period. In sort to get statistics explicit to New Delhi, this study investigates the presentation of a rooftop solar photovoltaic system installed on the roof of the Faculty of Engineering and Technology building of Jamia Millia Islamia University.

V. PERFORMANCE EVALUATION

A large spread and expansion of renewable energy are essentially required due to a rapidly growing demand for electricity. For sustainable widespread energy production and carbon-neutral energy, solar power generation is highly attractive. For the ground-mounted solar photovoltaic system, the performance ratio was reported at 0.8 and for rooftop, it was 0.75 published by Environment Canada. The execution proportion (PR) of the sun-oriented plant has been assessed by revealing the impact of normal temperature, season of hour (TOH), sun-based irradiance on the force age, what's more, proficiency of the plant.

The performance ratio (PR) is a measure to calculate the execution of the photovoltaic system and calculated as follows:

$$PR\% = Ps \times 100\ I \times A \times Es$$

Ps is the total amount of output energy (kWh) of the system. 'I' represent irradiance (kWh/m2), 'A' shows the area of the array, the efficiency of the module is represented by 'Es'. While normalizing concerning irradiance, the impact of misfortunes is measured on the appraised yield.

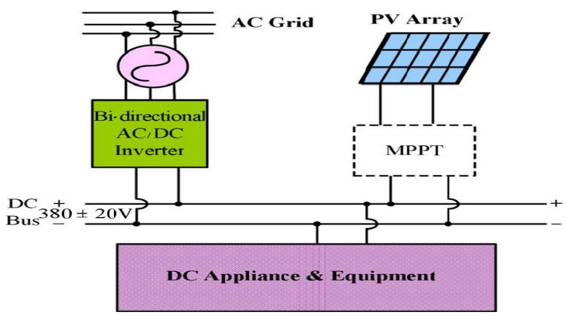

Fig 2 System Configuration of Proposed Model

VI. CONCLUSION

The optimal operating strategies for integration of distributed power generation with existing distribution grid and a special focus on a solar photovoltaic system for Indian condition has been discussed. In this thesis, the solar photovoltaic system is analyzed in detail with respect to performance ratio, performance under different radiant flux, the impact of climatic factors, power loss comparison in a single stage and double stage, degradation factor, optimal scheduling of microgrid, estimation of energy payback time and air pollution mitigation potential. On the basis of work done following important conclusions have been drawn and presented in this thesis.

A. The performance ratio is a measure of the quality of a photovoltaic plant and it is independent of location. This is also called the quality factor of a plant. The performance ratio varies between 0.7 and 0.8. The efficiency of a plant is higher when the performance ratio is higher. If the performance ratio of a plant deviates more with respect to a reference value, it indicates a prior fault. The power generation depends on incident irradiance on the photovoltaic array and it is maximum at noon but, the temperature is highest which creates more power loss hence efficiency becomes lower. From the simulation result, it is found that the power generation is minimum from mid-May until July where the temperature is maximum. Humidity and rain also affect power generation. The performance ratio depends on environmental factors such as the temperature of the PV module, solar irradiation and power dissipation, the measuring gauge (e.g. Sunny Sensor Box) is in the shade or soiled, PV module in the shade or soiled. The performance ratio of a solar photovoltaic power plant can be improved by implementing the tracking mechanism in a photovoltaic array to rotate according to Sun so that the panel could always face the Sun to get maximum irradiance and hence maximum power generation.

B. For optimal operation of the grid-connected solar photovoltaic power plant, efficiency should be higher. Double line frequency voltage ripple causes power loss in a single stage and double stage grid-connected solar photovoltaic system. By comparing the total power loss in a single-stage grid-connected solar photovoltaic system with a double-stage grid-connected solar photovoltaic system, it is found that the power loss is nearly the same but the single-stage grid-connected solar photovoltaic system has the advantage of reduced equipment like a boost converter. A single-stage grid-connected solar photovoltaic system is more efficient, cheaper, better system configuration, size, and feasible in dc distribution system. The Introduction of a battery in a single-stage and double-stage grid-connected solar photovoltaic system reduces the harmonic content significantly but increases the cost involved in the whole system. The efficiency of the solar photovoltaic array depends on pollution, particulate material accumulated on the surface. The rate of degradation varies between 0.55- 0.95 percent per year. The Solar PV inverter is the key equipment in converting the DC power generated by the solar PV plant into AC and fed to the grid. Appropriate infrared filtering and observing can recognize issues to be remedied before an inverter disappointment that could bring about misfortune in megawatt creation. It is suggested that the efficiency of the solar photovoltaic power plant can be increased by proper cleaning of the panel so that the panel could receive maximum irradiance. The Shading effect can be minimized by removing weeds and hence getting higher efficiency.

C. Battery energy storage controlled by a fuzzy system is required for uninterrupted power supply to the loads connected with the microgrid. An uninterrupted power supply is highly important for some sensitive equipment. The cost of energy generation can be minimized and at the same time, the dependency of customers on the main grid is reduced by using a battery energy storage system. The charging and discharging of a grid-connected battery energy storage system has been controlled by the fuzzy control system and therefore the output power of the battery, the power supplied to load and the state of charge of the battery has been optimized. A microgrid with battery energy storage controlled by a fuzzy system require to add with a central grid to improve power quality, increased reliability, avoid the use of depleting fossil fuels, improve technical performance and reduce greenhouse gas emission. Thus, it's suggested to install a larger capacity battery than the microgrid needs. The depth of discharge should not increase by more than 50% for longer life. Proper maintenance, coupled with automation and battery management, can further reduce labour and increase lifespan. It is fount relatively good for the north eastern regions of Brazil. The performance ration and capacity factors were also measured and found 82.9% and 19.2% correspondingly. Aslan Gholami et al. have developed an experimental setup for 70 days to identify the blow of and amassing on the performance of the photovoltaic system in Tehran, Iran. This investigation showed that without rain too much dust was accumulated at the PV array's surface which reduces power-generation significantly. This reduction in power generation arises due to dust accumulation was such that three hectares of forest would be required for absorbing carbon.

D. Walid A. Omran et al.have suggested that the fluctuations in mega-power generation can be reduced by using some methods like uses of the storage system of battery, uses of the dump load by operating a conditioning unit of power below the maximum point of power. M. Malvoni et al. have investigated the working efficiency of the system of 960 kWp photovoltaic (PV), which is located in the southern part of Italy. The analytical result gave reliable data and shows their better performance as compared to other plants which are located in the same climate. The uses of these outcomes are to predict PV systems working in this climatic zone and can also be used to do comparative studies. K. Padmavathi et al. have done the analysis which is based on the experiment for a 3 kW grid-tied system of solar photovoltaic that is located in India in Karnataka Nipon Ketjoy et al. have presented the working efficiency of a 10 KWp solar photovoltaic power generation. They have conducted the investigation for 6 years under hot climatic conditions

REFERENCES

[1] https://www.researchgate.net/publication/275533495_Performance_Evaluation_of_10_kWp_Photovoltaic_Power_Generator_Under_Hot_Climatic_Condition
[2] https://dokumen.pub/evolutionary-computing-and-mobile-sustainable-networks-proceedings-of-icecmsn-2020-1st-ed-9789811552571-9789811552588.html
[3] https://www.researchgate.net/publication/299499671_Optimal_Load_Sharing_of_Hydrogen-Based_Microgrids_with_Hybrid_Storage_Using_Model_Predictive_Control
[4] https://www.researchgate.net/publication/256080349_A_Degradation_Analysis_of_PV_Power_Plants
[5] https://www.academia.edu/36158313/Utility_Scale_Solar_Photovoltaic_Power_Plants_In_partnershIp_wIth_a_project_Developers_GuIDe
[6] https://www.researchgate.net/publication/234080597_High_gain_single-stage_inverter_for_photovoltaic_AC_modules
[7] https://link.springer.com/article/10.1007/s10209-014-0348-1
[8] http://reports.ias.ac.in/report/19259/islanding-condition-its-causes-mode-of-origination-and-detection
[9] http://www.ijrrr.com/papers6/paper5.pdf
[10] https://www.frontiersin.org/articles/10.3389/fenrg.2020.00111/full