An Optimal Load Shedding Scheme by Hybrid Sources

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Abstract: The benefits of DC power systems in distributed systems and micro grids are gaining growing interest. Many delivery generations, such as PV, fuel cell and batteries have a normal DC output on the energy supply side.DC micro grids can now be used in many areas and potential smart DC micro grid growth systems are being used to combine distributed processing and automated electronic charges with high performance. This article focuses on the self-contained functioning of micro grids, in particular the island mode of activity during a grid disruption. For an island micro grid, we suggest priority hierarchical operating control. This conceptual effective implementation of a modern load shedding system and a multi-agent hierarchy for resilient micro-grids. Currently, increasingly growing requirements in power systems can cause overloading of electrical systems. This overload leads to a major outage in certain cases unless correct load removal is carried out. The load shedding scheme that was suggested helps the system operation to secure electricity for large loads, taking into consideration the priority of loading in the micro grid during a grid problem To defend the power grid against voltage fluctuations, the load shedding system must be reliable and optimal. In exchange, this allows industry management to supply constant load capacity without interruption.
Keyword – Distributed power systems, island mode, grid disturbance, load shedding scheme, priority of loads, optimal load shedding.

I INTRODUCTION

Renewable energy industry has experienced significant progress over the last 30 years. The photovoltaics and wind conversion system (WECS) are exciting and growing fast. Photovoltaic (pv) systems have grown exponentially in recent years and at the end of 2014 they reached 178 GW. In many island nations, the windmills were used to generate electrical energy, and later the technology generated several significant progresses in the field of power engineering and the best emission-free electricity. Fuel cells are electric cells which transform the fuel into chemical energy. This will provide energy with food and oxygen. Fuel cells act as a replacement in hybrid supply schemes to other sources of energy including solar energy and gas.

An problem statement is now being discussed on the energy shortage in Pakistan's power market. The consequence of charging dumping, when the power supply-demand gap continues, is a practical solution. PV, WECS and fuel cells help stop disruptions and preserve the reliability of the grid. The proposed prototype was introduced for the purpose of providing continuous supply using load dumps to meet industrial requirements. The power network should provide energy for high voltage failures or other power transmission issues to the sector. A unique prototype was developed in an industry to supply through accelerating energy. In the event that the load enters operation in large demand, the planning of load and execution are given priority for the high demand.

II PROPOSED TECHNIQUE

In order to meet their needs, businesses require a continuous energy supply to be manufactured. If Grid side inputs are interrupted, the consumer demand is suddenly ineffective. The load must be prepared carefully for demand before adding the high demand load. It should have been considered as a subsequent correlation if organization requirements are constantly fulfilled. Renewable energy sources such as solar, wind and fuel cells must be used to turn this setup into commercial microgrids. Which approach operates in isolated mode whenever electrical sources are blocked from the closest delivery network.

The energy conversion from renewable energies to multiple charges must be carefully handled to address the problems of reliability and electricity efficiency. A proper architecture has therefore been deployed to avoid discontinuity in power, voltage and voltage operations, ensuring that the loads perform well.

III METHODOLOGY

Via simple programming tools called MATLAB 2017, the proposed approach can be technically defined. Simulink offers a graphical editor for modeling and simulating complex structures, adaptable block libraries and solvers. These are embedded with MATLAB, which allows MATLAB functions to be used in prototypes and import effects to still be evaluated deeper. We need four Simulink blocks to construct this basic model. We can choose from a variety of fixed-stage and variable-stage solvers to simulate continuous, discrete and mixed signal systems. Simulink builds and simulates easy a high-performance platform. Production specialist examines constraints that can slow down the simulations. The tool can change the model automatically to satisfy the requirements or you can manually verify and enforce recommended changes. Figure 1Displays the basic schematic diagram of the technique suggested.

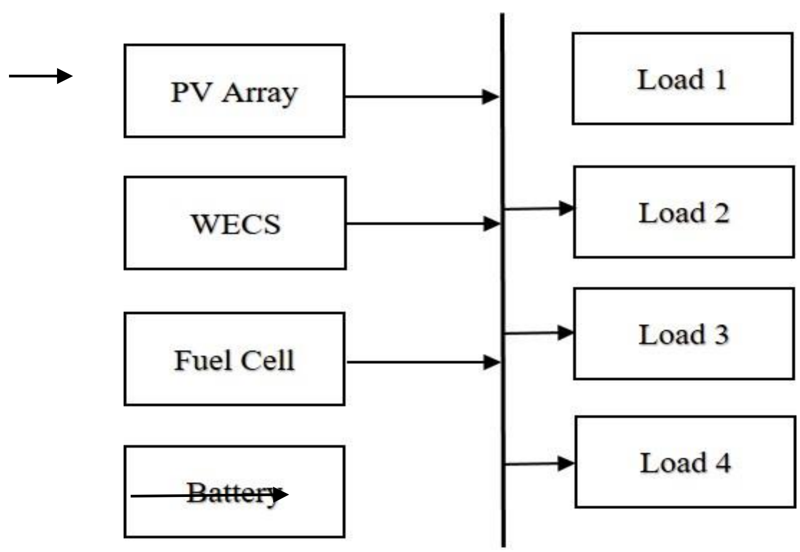

Figure 1 Block Diagram of Proposed model

In the proposed model, renewable energy sources PV array, WECS, Fuel Cell stack and Battery are connected to a single DC busbar line.The transmission of power to different load demands in the industry is done through this bus bar.Every renewable source acts as a backup to other so that continuous power dispatch shall be delivered to the loads. Suppose in an instance, if one of the renewable source say PV array fails to supply power during cloudy days, either a fuel cell or wind power shall meet the deficit and supply continuous power to the end user. This prevents the industry from total blackout. The proposed model is considered as a simple microgrid.

A. DESIGNING

The proposed topology has been designed using a simple programming software called MATLAB 2017.Renewable sources PV array, WECS, fuel cell stack and a battery are designed using this software. The designing parameters and other terms are discussed here.

B. DESIGNING PV ARRAY

The designing of real time application of a solar energy system is done using a maximum power point tracking algorithm.**Designed solar PV array** has the ability to draw 1100 watts. A module's performance physically defines the area of the module given the same rated output, i.e. an 8% effective 230-watt module has a range of 16% efficient 230-watt module twice.In industries machines of different ratings are under demand, so the energy consumed by these loads are to be calculated by the equation (1.1)

Energy Consumption=Power rating of loadXQuantityXhours used. (1.1)

In the Figure 2 Simulink, A MPPT algorithm has been assigned in the subsystem to track the maximum power from the sun.PV array is designed and the output of solar panel is 150V DC supply. This low voltage is insufficient to run the machine. So, a IGBT switching device is used to boost the 150V DC of lower order to 450V DC of higher order.The universal bridge in the circuit shows the simple H-Bridge inverter using IGBT switching devices which convert the DC supply to a three phase AC power. Power quality problems are major constrains which are caused by harmonic distortions.RL and LC filter were designed in the PV design in order to require pure three phase AC sine wave in scope 1.

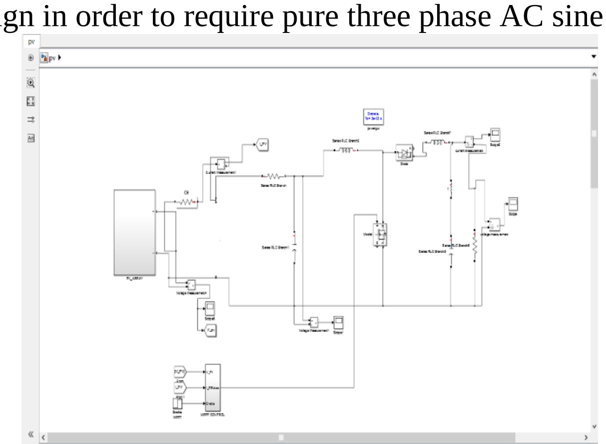

Figure 2 Simulink model of PV array

C. DESIGNING WECS

A variable wind turbine achieves the wind power conversion system (WECS). There is a growing interest particularly in the use of storage devices for power smoothing and load levelling applications in wind energy systems. The mechanical power produced by the wind energy is transformed to useful energy by means of a low rpm power generator. Figure 3 shows that the WECS Simulink model is built using an induction generator. For high efficiency and longevity, the Doubly Fed Induction Generator (DFIG) is deployed here. With reduced costs and power shortages, the DFIG provides the benefits of speed management.

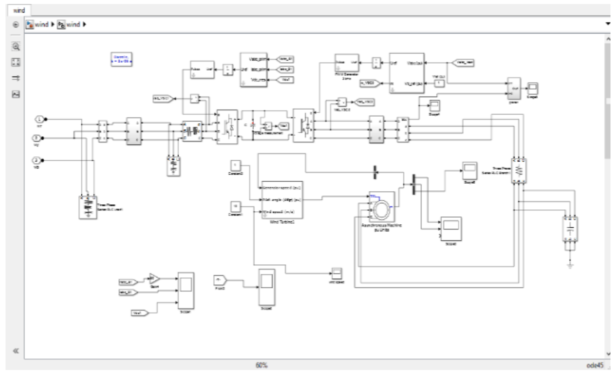

Figure 3 Simulink circuit model of WECS

The relationship between the rotor velocity and the frequency of an AC voltages caused through mathematical windings is equated with traditional inductive generators (1.2).

$$f_{stator} = N_{rotor} X N_p (1)/120 \quad (1.2)$$

That fundamental concept in a DFIG is the same as the regular generator induction. Figure 4 demonstrates this. The main distinction is that there is not static magnetic field inside the rotor. The key aim of using a DFIG is to produce three-phase stress, with a constant frequency similar to the AC power network frequency network

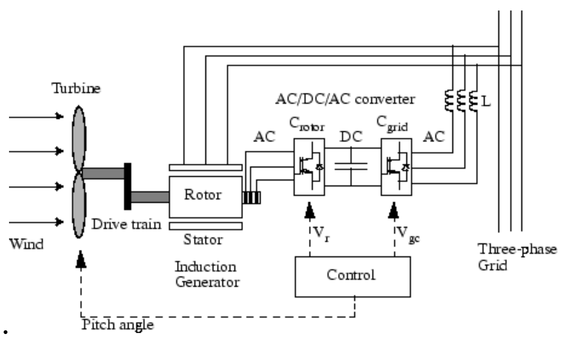

Figure 4 DFIG fed WECS

D. DESIGNING FUEL CELL STACK

In this proposed topology, we have utilized one more renewable source called fuel cell. Here we have employed fuel cell in order to make them to be intact with other renewable sources like solar and wind energy.This fuel cells vary from batteries in order to maintain the chemical reaction by a steady fuel and oxygen supply. They therefore will continually generate energy as long as the availability of fuel and oxygen. Like batteries, each cell is stacked for higher voltage and more power. This cell assembly is known as a fuel cell stack. It depends on the scale of the power output for a specific fuel cell stack. Raising the number of neurons in a heap enhances voltage and increases the current density of both the cells. Figure 5 displays the fuel cell stack simulacrum model circuit.

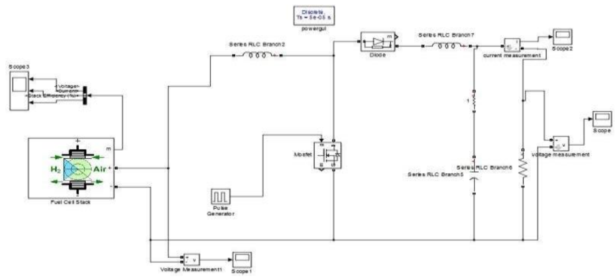

Figure 5 Simulink circuit model of fuel cell stack

The fuel cell stack has been designed in a Simulink subsystem. When the climatic conditions are adverse i.e., during cloudy days, solar panels cannot generate the energy so that it can be compensated by this fuel cell stack. Similarly, during non-windy days wind turbines cannot generate energy as per the requirement. This problem can be resolved by making the fuel cell to compensate the energy demand. As we have seen earlier every renewable energy source acts as a supportive source to eachother. Structure of the fuel cell stack is shown in Figure 6.

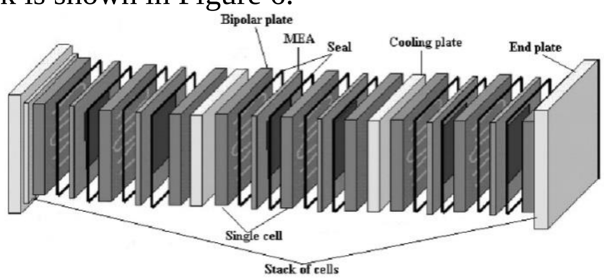

Figure 6 Fuel Cell stack

E. DESIGNING BATTERY

The energies from solar, wind and fuel cell are discontinuous since they depend on some natural resources that are not continuous. Our theme of this proposed topology is to supply the continuous power to industrial loads without any interruptions. So, we have designed a Simulink model of a battery in a subsystem that is shown in Figure 7

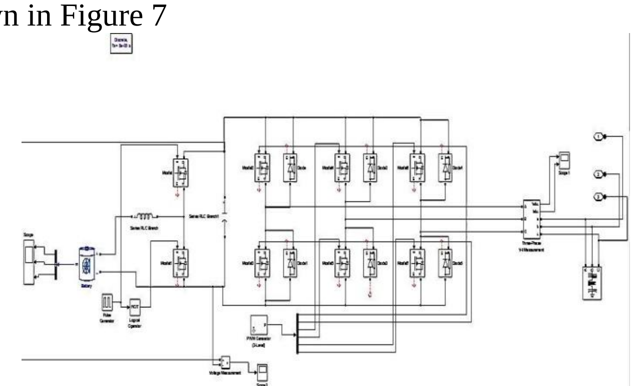

Figure 7 Simulink circuit model of Battery

The solar array, wind turbine is connected internally in a bidirectional link so that the generating power from PV array and wind turbine is stored continuously in the battery. The proposed model acts a small microgrid that lies within the industry to supply continuous power and even works in islanded mode when there is a complete blackout in nearby distribution station. Two modes of operation in battery have been designed in this model. Charging modeand discharging mode. It prevents the life of the battery by monitoring it during charging and dischargingcondition.

IV SIMULATION RESULTS AND DISCUSSIONS

From the scope block we can obtain the three-phase sinusoidal waveform that has to be fed to the load. In the output graph, we had chosen the time period in x-axis and amplitude of voltage in y-axis. By FFT analysis we had calculated the THD values and thus formulated and tabulated. The waveform output of a three-phase sine wave is given in the Figure 8.On analyzing the proposed system with the existing design, we can assure that the domination of odd harmonics has been rectified by means of an LC filter. By this the stability of the system gets more stabilized owing to the existing model. ThiscanbetabulatedinthefollowingTable1.Theratedpoweroftheproposed design is 250kW i.e., comparatively high than the existing model, this results in increase in energy capacity of the module 6hr greater that the existingmodel.

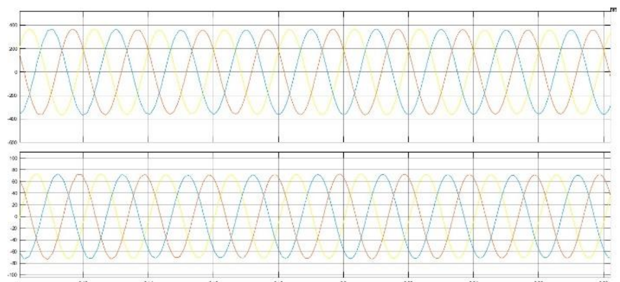

Figure 8 Three Phase sinusoidal waveform of load

The following table shows us the comparison results of existing and proposed systems. In the proposed model the frequency of the system is reduced to 50 Hz to get good efficiency. The switching devices like inverters and conductor’s switching losses has been reduced in the proposed model. From this the efficiency of the proposed model has been increased compared to existingmodel.

Module rated power	Existing system	PI logic system	Proposed system
AC voltage	350 V	440 V	305 V
AC-AC efficiency	70-80%	85-90%	90-92%
Switching losses	0.84%	0.6%	0.5%
Efficiency	85%	89.92%	90%

Table 1 Comparison results of existing and proposed systems

V CONCLUSION

An influence of the PQ study on the energy efficiency of the distribution center from the grid-connected Distributed generators. Summarizes the main the requirement for energy quality problems generated by the user-connected photovoltaic power plant. In one case of grid-connected photovoltaic output, this device simulated harmonic current injection in the grid and reactive power/voltage and studied it by designing photovoltaic and energy-grid-based models. Reactive power control capacity is the harmonic current generated by consumer side grid linked photovoltaic generation injection in the grid. The center of the proposed model is the continuous distribution of voltage without rampage. Each experiment functions as an islanded mode microgrid, when power from the delivery side is completely blocked. The high-request load is successfully met in tandem with other loads such that there can be no further PQ complications, such as tensile and voltage swell.

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