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ENERGY MANAGEMENT FOR INTERLINKED AC-DC MICRO-GRIDS

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Abstract- The existing power management schemes for inter-linked AC-DC microgrids have several operational drawbacks. Some of the existing control schemes are designed with the main goal of sharing electricity many of the interlinked microgrids based on their loading situations, at the same time as other schemes adjust The voltage of the interlinked microgrids without thinking about the unique loading situations. However, the existing schemes cannot achieve both objectives efficiently. To address these issues, an autonomous power management scheme is proposed, which explicitly considers the specific loading condition of the DC micro-grid before importing power from the interlinked AC microgrid. This approach allows voltage law in the dc microgrid, and also reduces the range of converters in operation. The proposed scheme is completely self sustaining while it keeps the plug-n- play features for mills and tie-converters. The performance of the proposed control scheme has been tested below special working scenarios. The effects exhibit the effectiveness of the proposed scheme in handling the electricity deficit within the dc microgrid efficaciously and autonomously at the same time as maintaining the better voltage law in the dc microgrid.

Index Terms—Autonomous control, distributed control, droop control, hybrid microgrids, interlinked microgrids,

1.1 Micro-Grid

As electric powered distribution technology steps into the following century, many developments have become important so one can exchange the requirements of power shipping. These modifications are being driven from each the call for aspect in which higher energy availability and performance are desired and from the supply aspect wherein the integration of disbursed generation and height shaving technology must be accommodated [1].

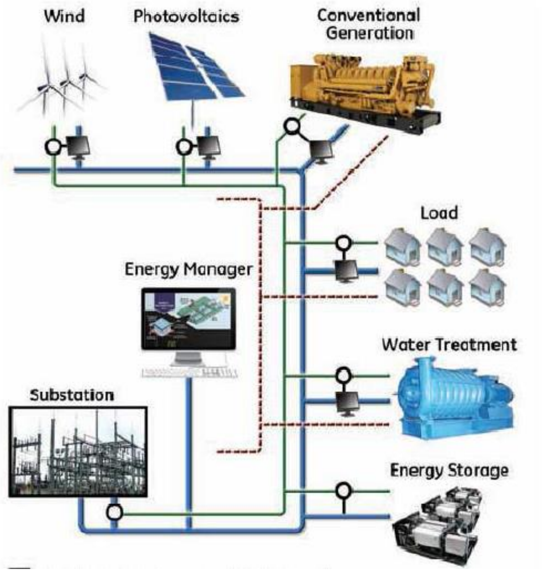


Fig 1.1 Micro grid power system

The micro grid often supplies both electricity and heat to the customers by means of combined heat and power plants (CHP), gas turbines, fuel cells, photovoltaic (PV) systems, wind turbines, etc. The energy storage systems usually include batteries and flywheels [2].The storing device in the micro grid is equivalent to the rotating reserve of large generators in the conventional grid which ensures the balance between energy generation and consumption especially during rapid changes in load or generation.

1.2 Technical challenges in Micro grid

Safety device is one of the predominant challenges for micro grid which have to react to both fundamental grid and micro grid faults. The safety device must cut off the micro grid from the primary grid as swiftly as essential to defend the micro grid hundreds for the first case and for the second case the safety machine have to isolate the smallest a part of the micro grid while clears the fault [30]. A segmentation of micro grid, i. E. A layout of multiple islands or sub micro grids need to be supported by way of micro source and cargo controllers. In these situations problems related to selectivity (fake, useless tripping) and sensitivity (undetected faults or not on time tripping) of safety machine might also get up. In particular, there are two major problems concerning the safety of micro grids, first is related to a number of mounted der gadgets within the micro grid and second is associated with an availability of a sufficient level of quick-circuit modern-day inside the islanded running mode of micro grid in view that this degree might also appreciably drop down after a disconnection from a stiff primary grid.

I. METHODOLOGY

2.1 Micro grid

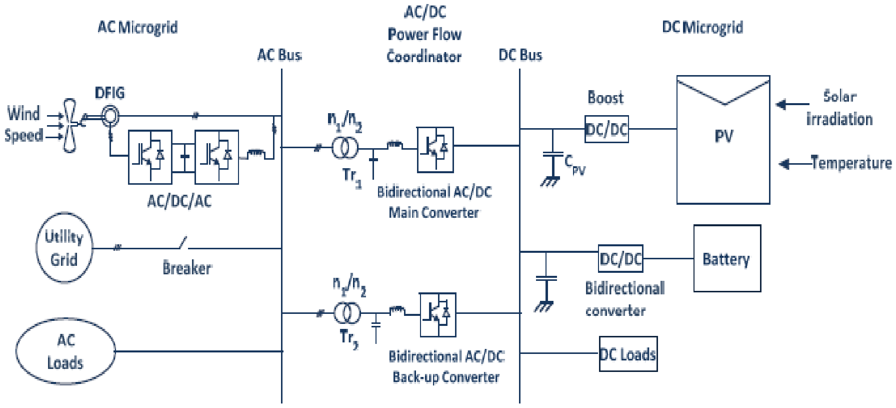


Fig 2.1 A hybrid AC-DC micro grid

The concept of micro grid is considered as a collection of loads and micro sources which functions as a single controllable system that provides both power and heat to its local area. This idea offers a new paradigm for the definition of the distributed generation operation. To the utility the micro grid can be thought of as a controlled cell of the power system. For example this cell could be measured as a single dispatch able load, which can reply in seconds to meet the requirements of the transmission system. To the customer the micro grid can be planned to meet their special requirements; such as, enhancement of local reliability, reduction of feeder losses, local voltages support, increased efficiency through use waste heat, voltage sag correction [3].

2.2 Control of AC and DC Micro grids:-

The taken into consideration dc micro grid consists of a non-dispatch capable generator (solar-pv) and dispatch capable generators (micro turbine, fuel-mobile) and hundreds, as shown in fig. 1. The non dispatch in a position- sun pv device is about to operate in contemporary control mode and as a result extracts maximum electricity at all of the times. The dispatch capable mills are commonly used for toning the renewable potential and may be managed both thru a centralized or decentralized manage scheme. The decentralized stoop scheme is the most widely used and favored, as it is easy and reliable. Consequently, the conventional droop (p-v) scheme has been used for the dispatch capable mills of the dc micro grid (see fig. Three. 1), which is given through

$$\mathbf{V_{dc\,,ref,i} = V_{dc,max} - \delta_{dc,i} P_{dc,i}}$$

$$\eth_{dc,I} = \frac{Vdc,\max - Vdc,min}{Pdc,max,i} = \frac{\Delta Vdc}{Pdc,max,i} \qquad (1)$$

where, i is the DC generator number (i = 1, 2, 3. . .); Vdc, ref, I is the reference voltage of ith generator; Pdc, I is the output power of ith generator; Vdc, max and (V dc, min = Vdc,nom,TC1) are the defined maximum and minimum voltage; Pdc, max,I is the maximum or rated power of ith generator; and ∂dc ,I is the droop gain of ith generator. Based on (1), the voltage reference for the droop controlled generators 1 and 2 can be calculated by (2) and (3). As generators 1 and 2 share common DC bus voltage (i.e.,Vdc,ref,1 = Vdc,ref,2), (2) and (3) can be equated and rewritten by (4), which demonstrates that the droop controlled generator will share proportional power according to their rated power capacity.

$$V_{dc,ref,1} = V_{dc,max} - \eth_{dc,1} P_{dc,1} \tag{2}$$

$$V_{dc,ref,2} = V_{dc,max} - \eth_{dc,2} P_{dc,2} \tag{3}$$

$$\eth_{dc,1} P_{dc,1} = \eth_{dc,2} P_{dc,2} \longrightarrow \frac{Pdc,1}{Pdc,max,1} = \frac{Pdc,2}{Pdc,max,2} = \frac{Pdc,i}{Pdc,max,i} \tag{4}$$

The equality in (4) is based on the fact that the voltage at the generator terminals is the same. Practically, the voltage at all the generator terminals is not the same due to the fact that they are connected through feeders/cables of different lengths. This voltage mismatch at the generator terminals affects the power sharing accuracy, which needs to be compensated by using any of the appropriate compensation methods [26], [27]. The droop equation with compensation of the feeder voltage drop can be rewritten by

$$V_{dc,ref,i} = V_{dc,max} - \eth_{dc,i} P_{dc,i} + i_{dc,i} X_i \tag{5}$$

2.3 Hybrid Control of Tie-Converters

The energy rating of dispatch capable mills or storage systems for firming the renewable capability depends on the variety of the renewable source and hundreds inside the micro grid. The excessive variability of renewable and loads requires dispatch able mills or garage systems with a high energy score, which might also or might not be a possible answer. As a substitute, the micro grid with insufficient era capability will be interconnected with some other micro grid or utility grid directly or through harmonizing converters.

II. SIMULATION &RESULTANALYSIS

3.1 Simulink model of Proposed System

Simulation model:-Case –I (DC micro grid with micro turbine, fuel cell, and load)

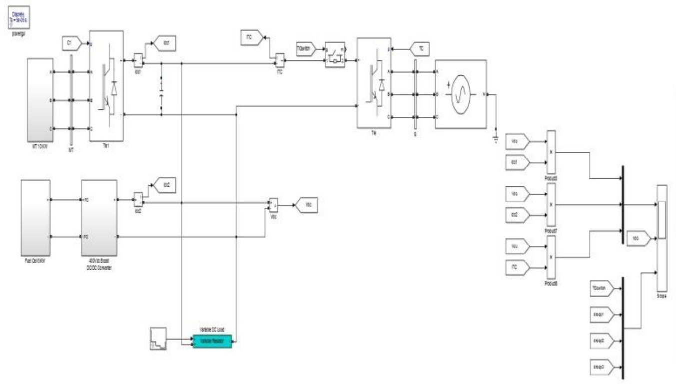


Fig .3.1.1 Simulink model of Microgrid-1

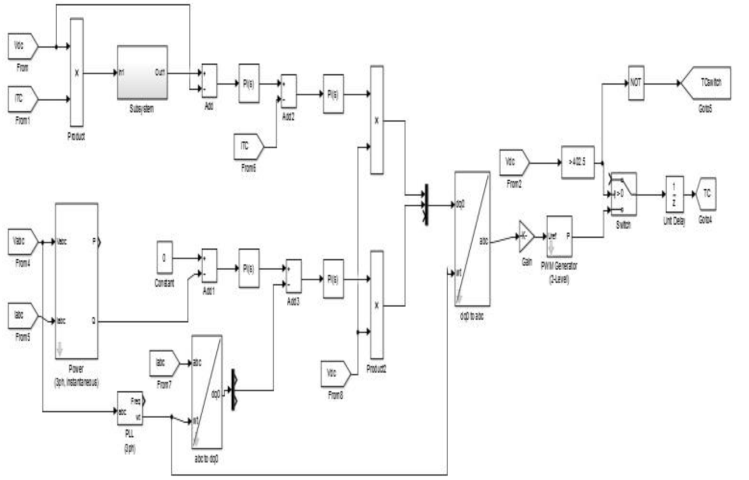


Fig .3.1.2 Simulink model of Microgrid-2

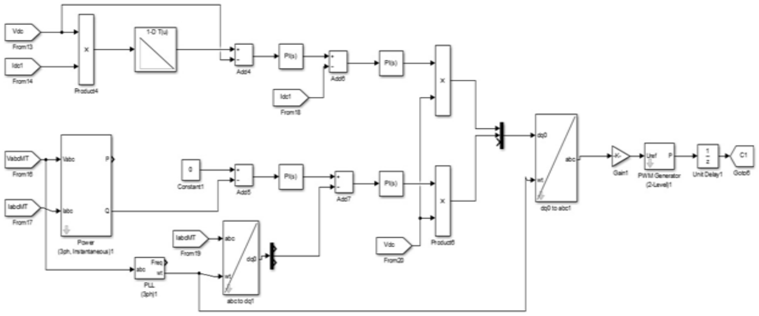


Fig .3.1.3 Simulink model of Microgrid-3

3.2 Simulation Results & Discussion for Case-I

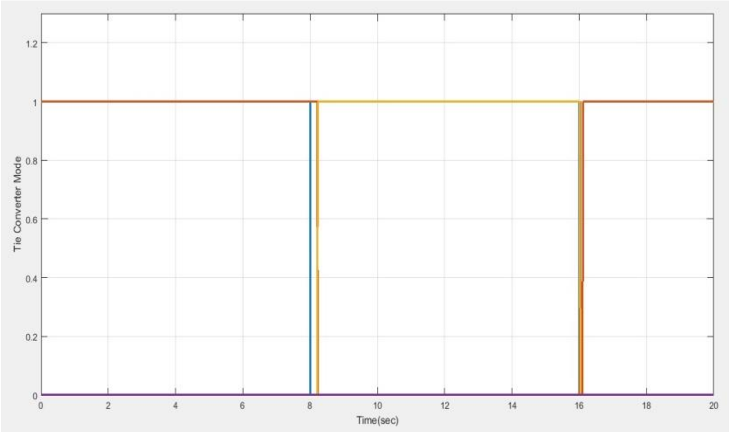


Fig.3.2.1 Simulation Results of Tie Converter Mode

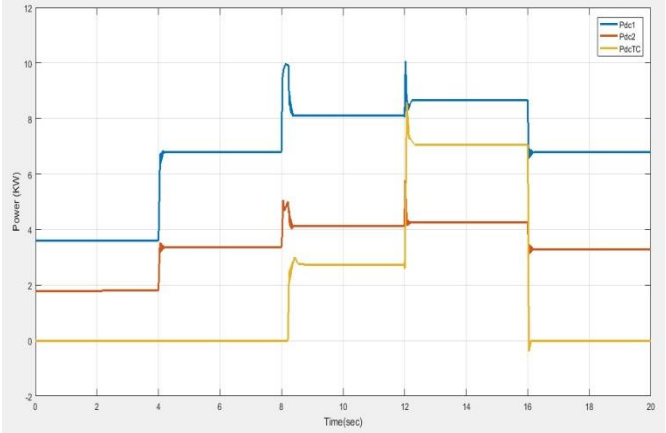


Fig 3.2.2 Simulation Results of Power Management

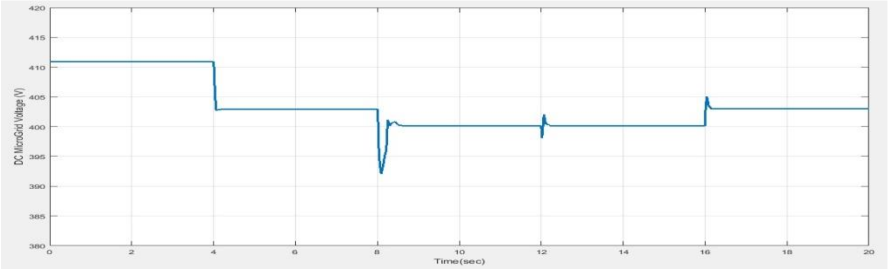


Fig 3.2.3- Simulation Results of dc Micro grid Voltage

3.3 Simulink Model for Case –II (DC micro grid with micro turbine, fuel cell, Solar PV and load)

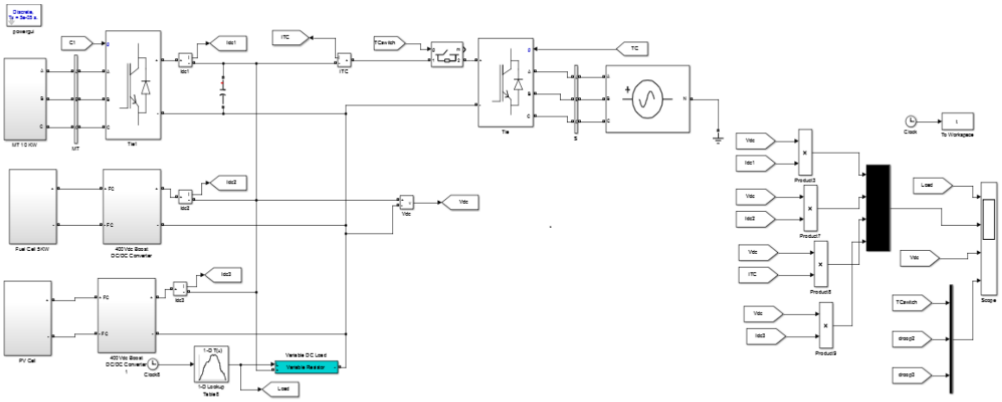
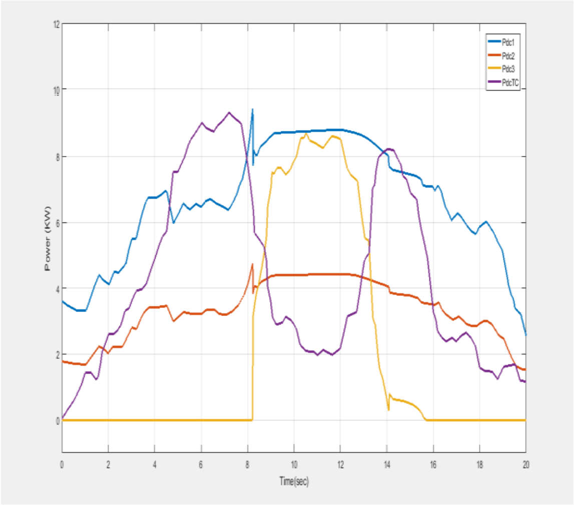


Fig 3.3- Simulink model of Case-II



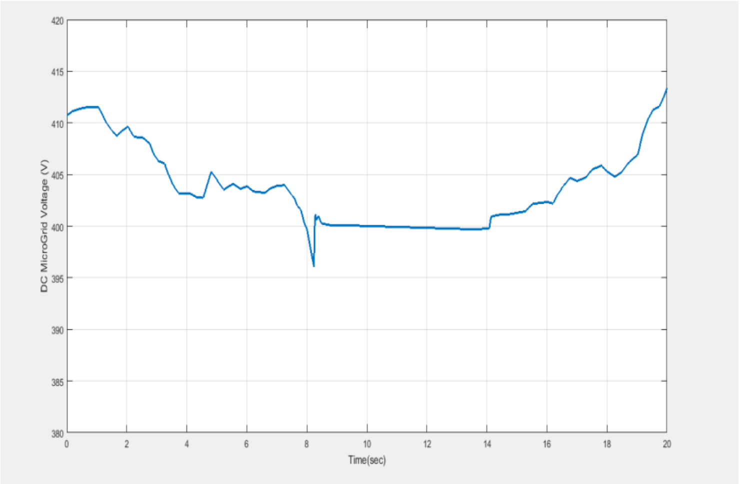


Fig 3.3.1- Simulation Results of Power Management for Case-II Fig 4.22- Simulation Results of dc Micro grid Voltage for Case-II

III. CONCLUSION

. An self sustaining energy management scheme has been supplied for interlinked ac-dc micro grids having specific configurations. The proposed scheme manages the energy deficit inside the dc micro grid efficiently and autonomously. The wide variety of tie-converters in operation has been reduced with the proposed prioritization to avoid useless operational losses. The scheme has verified better voltage law in the dc micro grid. The performance and robustness of the proposed scheme have been confirmed for 2 distinctive eventualities of the dc micro grid at variable load situations.

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