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Priority-based Mutual Power Sharing between Microgrids in a Community Microgrid

Nabanita Chakraborty[1*], Subhadip Chandra[2], Ambarnath Banerji[3], Sujit K. Biswas[4]

[1] Electrical Engineering Department, Meghnad Saha Institute of Technology, Kolkata, India
E-mail: nabanita.chak2007@gmail.com
[2] Department of Computer Science and Engineering - Artificial Intelligence and Machine Learning, Institute of Engineering and Management, Kolkata, India
[3] Electrical Engineering Department, Narula Institute of Technology, Kolkata, India
[4] Department of Electrical Engineering, St. Thomas' College of Engineering and Technology, Kolkata, India

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***Abstract*—** Several microgrids (MG) operating in the neighborhood can be integrated to form a community of MGs to harness several benefits of a larger networked system. The present research is an investigation of the coordination between the several AC and DC MGs of such community MG. Individual MGs may function as self-contained entities, but they might also collaborate with other nearby MGs to provide backup operations in the community MG. In this paper a coordination technique is suggested for transmitting excess power of a MG to the community bus under the control of the community MG controller so that nearby MGs can use it as needed, while maintaining stable operation of the participating MGs. A centralized controller called the community MG controller maintains the coordination between the neighboring MGs. The controller receives power shortage report from the MGs facing power shortage problem and decides as to which MG can draw this excess power. The controller uses a priority-based distribution algorithm to decide the allocation of power. The algorithm takes into consideration the presence of critical loads like hospital, industry, academic institution, etc. An infrastructure of smart metering (SM) is used to check the amount of power flow into any MG. The MGs will be penalized if they draw power more than that allocated to them. Thus, each MG is able to maintain stable operation without having to resort to spinning reserve for excess load and dump load to remove the excess power from the system. The obtained simulation results show that the suggested approach is a practical and efficient means of coordinating power flow in an islanded community MGs.

***Keywords*—**Community microgrid; Community bus; Microgrid controller; Smart Metering; Power sharing.

1. INTRODUCTION

The traditional electrical grid is a sizable electrical network made up of extensive transmission and distribution networks, energy consumers and huge fossil-fuel based power plants. Power losses experienced during long-distance transmission lowers energy efficiency, while fossil fuels raise the carbon footprint on the environment. As a result, the power sector is confronted with a variety of challenges, such as a growing need for electric and thermal energy, dependability, protection from multiple environmental threats, clean energy and planning limitations. Furthermore, when a significant blackout occurs as a result of any accident or natural disaster, consumers also suffer [1]. Due to concerns about the environment, clean renewable energy sources (RESs) must now be incorporated into the system [2]. Gaziantep Islamic Science and Technology University (GIBTU) in Turkey plans to have its electricity demands met by a grid-connected rooftop photovoltaic (PV) system [3].

* Corresponding author
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The concept of a microgrid (MG) evolved to reduce these types of occurrences. A microgrid is a small-scale electrical grid that can operate independently or in parallel with the Distribution system. A localized entity, MG is made up of distributed energy resources (DERs) and controlled thermal and electrical loads [4]. It typically consists of RESs such as solar photo-voltaic panels (PV), and wind turbines (WT) connected to the MG to reduce the reliance on fossil fuels, along with battery energy storage (BES). They can help to increase energy efficiency, reduce greenhouse gas emissions, and improve the reliability and resiliency of the power system. Microgrids can be used to provide reliable and resilient power to communities, especially in remote or off-grid locations, or to support critical infrastructure such as hospitals, data centers, and military bases. In addition, microgrids can be designed to provide services such as frequency regulation, voltage control, and demand response, which can help to optimize the operation of the grid. A reduced-level model of a microgrid system for the university community in Nigeria is presented using MATLAB/ SIMULINK [5].

When groups of nearby microgrids are connected by a community interface controller, a community microgrid (CMG) is created. A cutting-edge idea to benefit from the cooperative operation of nearby MGs is MG clustering. Applying an energy management system (EMS) is necessary in order to reach the desired objectives, which are achievable by the MG and CMG idea [6]. According to the established MGs strategy and schedule, EMS is responsible for ensuring the efficient and effective functioning of MGs. To fulfill the energy requirement, it uses locally accessible distributed generators (DGs), including microturbines (MT), fuel cells (FC), solar photo-voltaic panels (PV), and energy storage systems (ESSs) [7]. To determine the optimal power of DER units, such as wind turbines (WTs), ESS, micro-turbines (MTs), as well as customer consumption patterns, an EMS is presented [8] in the JADE software environment. Through simulation on a DC Microgrid, an energy management method is studied and validated [9]. Researchers have used the size and localization of various DGs to minimize the loss and expense of MGs utilizing multi-objective optimization approaches [10]. Residential consumers can harvest energy and inject it into the distribution systems, thanks to an increase in the deployment of distributed generators and energy storage systems with intelligent infrastructures. With this development, residential consumers become prosumers. A prosumer is a person or thing with the ability to generate, consume, and perhaps even respond to demand [11]. Individual microgrids may work together with other nearby microgrids for economic and emergency backup operations. The advantages of both AC and DC Microgrids might be combined in a CMG, which would also increase the economic performance and dependability of individual microgrid systems. Each microgrid would have its connections to the main grid and be linked to others in the neighborhood.

A hybrid microgrid is different from a community microgrid since it primarily consists of a single microgrid that combines ac and dc configurations for easier integration of dc sources and loads, but a community microgrid manages a group of interconnected ac and dc microgrids situated in nearby regions. Due to the rise of dc sources and loads in the ac-dominated environment, interest in these microgrids is expanding significantly.

The bidirectional community interface controller, which connects the ac and dc sub-grids, is a key component in the functioning of hybrid microgrids [12], and it has received a great deal of attention in research on their coordinated control strategy. The community microgrid concept, in which microgrid regions connected by regulated interconnecting links directly communicate with their surrounding regions, is presented briefly [13]. The structure and benefits of a community microgrid in which each microgrid is tied to the main grid and to other microgrids in the community via a common ac bus have been outlined [14].

In relation to the CMG structure [15], control techniques [16], computational optimization [17], and methods of communication [18], numerous studies have been conducted in relation to MG and CMG applications. MG and virtual power plant concepts were thoroughly reviewed [19], and scheduling issues relating to the formulation and target functions, unpredictability, dependability, problem-solving techniques, reactive power and demand response are investigated. A review of hybrid renewable MG optimization strategies was done by Samir et al., [20] taking into account probabilistic, iterative, predictable and artificial intelligence (AI) methodologies. In [21], Carlos et al. examined the computational methods used in MG planning. The characteristics of distributed communication networks, problems with communication dependability and the classification of distributed control techniques were covered [22]. Hannan et al., conducted a thorough investigation on the traditionalization of optimized controller techniques with regard to the integration of RES into MGs and examined both sophisticated and traditional optimization algorithms in MG applications [23]. A survey on the main advantages and difficulties associated with the operation and control of the CMG is presented in [24].

In particular, when running the community as an island, the adoption of a community microgrid necessitates an effective plan to coordinate the power exchange among participating microgrids. The peer-to-peer (P2P) network is a popular resource-sharing paradigm in the area of computer science, where information on resources is stored on and delivered by computers (i.e., peers) at the network's edge [25]. A CMG can be modeled as a P2P network or microgrid-to-microgrid (M2M) network since it comprises many prosumers or Microgrids with their generation and demand that live close to one another. When excess energy from multiple small-scale DERs is exchanged locally, it is called peer-to-peer (P2P) energy trading [26]. Demand response (DR) to the resources available in a community and local energy trading is encouraged under the P2P paradigm [27].

Alam et al., [28] have suggested a P2P energy exchange concept for smart homes. With the unique optimization strategy to promote effective energy transfer without disclosure of data, [29] presents an effective and privacy-preserving P2P energy transfer strategy in a smart grid setting. To evaluate the economic effectiveness of P2P energy-sharing schemes, a model for the assessment of performance utilizing a number of indices is put forth in [30]. With the use of bill-sharing (BS), mid-market rate (MMR) and auction-based pricing schemes, Long et al., [31] proposed various P2P market conventions, however, without DR being taken into account. The multi-leader-multi-follower Stackelberg game is a competitive market-based distributed system that has been developed in [32] for energy trading among microgrids.

In [33], demand response management (DRM) is examined from a variety of angles using the Stackelberg game theory. Numerous scholars have used a variety of game theoretic methods to conduct research on DRM, real-time pricing and energy sharing management in [34]. A distinct organization operates as an energy trading coordinator and was in charge of carrying out energy trading in these works [35].

In this paper, the main objective is to supply the excess power of any microgrid to the community AC main bus so that other microgrids in the neighborhood can use the power to meet their power deficits at their required time. The community Microgrid controller (CMGC) presented here will decide the priority-wise flow of excess power to the remaining microgrid by using a priority-based distribution algorithm. The excess power generation is not unlimited. Quite a few microgrids may be competing for this excess power. A priority is decided as to which microgrid (one or more) will be drawing this power: to what extent and for what duration. An algorithm is prepared for the same, which is the priority-based distribution algorithm. Based on this algorithm, the controller sends communication to the smart meter of the microgrids either allowing or denying them the excess power. The smart meter with the allow command will start drawing the power from the community bus for the duration it is allowed to draw. This is the priority-wise flow of excess power. If a microgrid is found to draw more than the allocated power or for a duration more than that allocated, it will be penalized.

The novelty of this present work lies in that it presents a method of utilizing the excess power in the neighborhood microgrids through a community bus to maximize the utilization of all the power generated, instead of wasting it in a dummy load. Hence each microgrid can have reduced installed capacity as it can bank on support from the neighboring microgrid. As a result, even during contingencies in a microgrid, it is not required to buy power at a high price from the utility grid as it can get the required power from the neighboring microgrids. As the generation of excess power is not unlimited, its distribution is done in a prioritized manner under the supervision of the Community microgrid controller so that maximum benefit accrues to critical loads.

In this paper, the CMG system model has been described in section 2. The distribution algorithm and its description with results are described in section 3. Sections 4 and 5 explain the community Microgrid architecture and simulation. Finally, the paper concludes through section 6.

2. SYSTEM MODEL

In Fig. 1, a community microgrid is presented by connecting several microgrids in the neighborhood with a community interface controller. The system establishes a community microgrid (CMG) with some MGs, smart metering (SM) infrastructure, and data communication between the various components. A community microgrid controller (CMGC) keeps track of all power transactions and keeps a record of them. It also makes contracts and calculates penalties on MG.

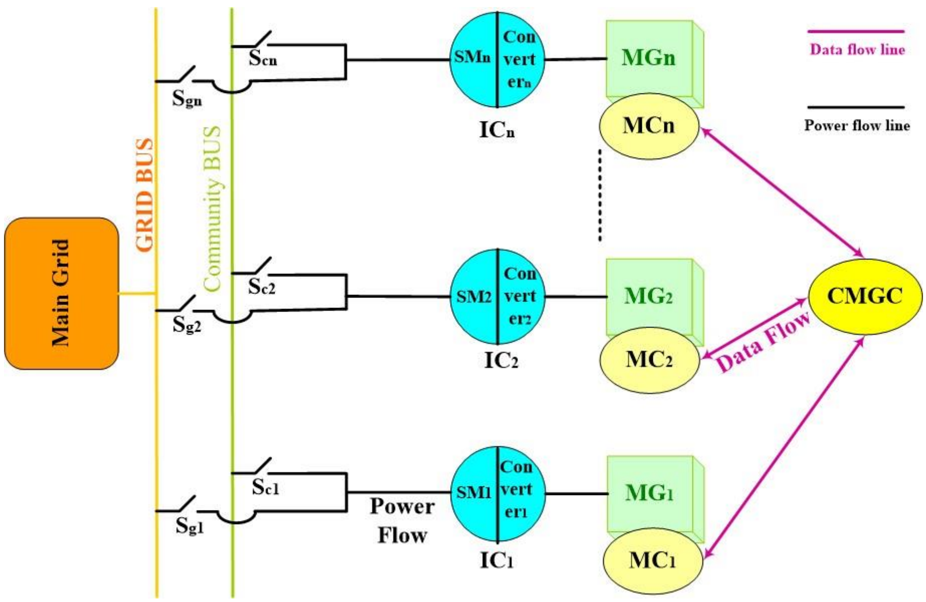

Fig. 1. Community Microgrid.

Each Microgrid will continue to be connected to the main utility grid while also being interconnected with other Microgrids in the area, each Microgrid can work with other Microgrids in the neighborhood to provide backup power so they can deal with emergencies and pursue economic goals.

The study makes the assumption that there is an interconnected network of '*n*' number of MGs that can exchange power. All microgrids include a smart metering (SM) network that keeps track of how MGs are connected to the community bus and the main grid also calculates how much power is actually being used in the microgrid. Additionally, the MGs have a Data Link (DL) which links it with CMGC to share power with other MGs and provide information about the condition of the MG connection. CMGC always investigates excess power present in any of the microgrids within the CMG. If the generated excess power from any of the MG is identified by CMGC, it will start looking at the demand conditions of the other MGs. At the same time, if the controller finds MGs with a shortage of power, it will communicate the excess power information with them so that they may draw the excess power from the community bus by using a priority-based distribution algorithm. The priority list of the MGs is already present with CMGC depending upon the presence of load in each microgrid such as hospital, industry, academic section, etc. SM is present in every MG to check power flow conditions between MGs as per agreement. A penalty will be imposed on the MGs if they start drawing power beyond the agreement. Additionally, a community microgrid combines the benefits of both AC and dc Microgrids, enhancing each Microgrid's economic performance and reliability. The configuration of CMG is shown in Fig. 1. The community's microgrids range from MG_1 to MG_n. By using the respective community interface controller (IC_1 to IC_n), microgrids are connected with community bus as well as with grid bus. The connection with buses is done through selectable electrical switches. For grid bus the switches are from S_{g1} to S_{gn} and for community bus the switches are from S_{c1} to S_{cn}. Over this connection, they can swap power and offer emergency backup taking the help of CMGC. Every microgrid has its own microgrid controller (MC) (MC_1 to MC_n). Excess power generated by any MG will send the excess report to CMGC. To enable the Microgrids to function autonomously, the ICs essentially act as a buffer between them. The IC acts as an ac-ac or ac-dc-ac converter in the case of an ac microgrid and a dc-ac converter in the case of a dc microgrid. Each microgrid has a backup connection to the utility grid, which increases resiliency in the event of unintended islanding.

The detailed workflow of the CMG taking the help of CMGC is presented in Fig. 2.

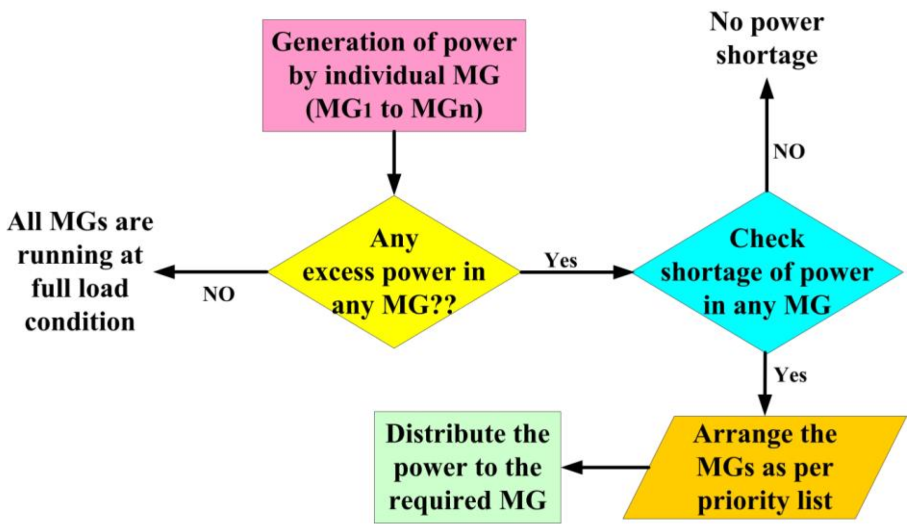

Fig. 2. Workflow diagram of the CMG.

Here, excess power generated by any Microgrid will send the report to the CMGC and it will start an investigation into the power condition of other MGs. If another MG or MGs at that time report a power demand due to shortfall, CMGC will decide how much excess power will be given to those MGs through a prior agreement. In order to choose which MG will receive surplus power first, CMGC uses a priority-based distribution algorithm.

Assume that P_i represents the excess power produced by source MG, S_i andX_j represents the present excess power consumed by B_j where B_j represents the MGs who are facing power shortage problem and send power shortage report to CMGC. The excess power generated by source MG is:

$$P_{excc} = \sum P_i \qquad i \in y \tag{1}$$

where y represents the source MG ($y<=n$).

The total power consumed by MG with power shortage is:

$$X_{short} = \sum X_j \qquad j \in (n-y) \tag{2}$$

When more than one MG submits a report for a power shortage, the priority list will be used by CMGC to determine which MG will receive the power first. Every MG has an SM system available to check the state of the power delivery, and if any MG is found to be using more power than was agreed upon, penalties will be imposed. If more than one MG submits a report for a power shortfall, the agreement will go as follows: the MG with the highest priority will receive the necessary power first, after which the second priority MG will receive power, and so on.

Power shortage reports come from MGs are at the same priority level then the excess power will deliver equally to the MGs.

$$X_{equ} = \frac{P_{excc}}{n-y} \tag{3}$$

Each MG which violates the terms of the power contract will be subject to penalties. These are priced at 10% of the rate for the main grid (SR_{main}) and are computed in terms of electricity. If an MG consumes more power (X_{extra}) than specified in the contract, the excess is charged as a penalty ($X_{Penalty}$), at a rate 10% higher than that of the main grid.

$$X_{Penalty} = \left(X_{extra} - X_{equ}\right) * 1.1 * SR_{main} \tag{4}$$

The advantages of the suggested architecture are given below:

- There is no need for individual microgrids to communicate with one another for power requirements. IC of every MG can send the excess amount of power to the community bus so that others can utilize the power during a crisis.
- There is no requirement for a high-bandwidth connection route between each MC.
- Due to the risk of communication failure, increased cost, complexity, and low robustness resulting from communication parameter uncertainties, either high-bandwidth channels or communication between any two microgrids are neither economically feasible nor practicable. Hence, it would be ideal to do away with such lines of communication.

3. DISTRIBUTION ALGORITHM

In the configuration of CMG presented in Fig. 1, each microgrid is connected with other microgrids via community bus using a community interface controller. If power generation by any of the microgrid present in CMG is not fully utilized by its own load, then the excess power can be shared with other MG present on the same CMG with the help of CMGC. The excess power is sent to the community bus and the excess report is shared with CMGC. At the same time, if any power shortage report reaches the controller, it will process the excess power present in the community bus to the required MG. The power shortage report can come from more than one microgrid at the same time. After that, a priority-based distribution method will be used by CMGC to determine which MG/MGs will get the excess power sharing. In a community-based microgrid, priority-based load distribution includes allocating and managing power loads in accordance with predetermined priorities.

Here is a general strategy for sharing power in a microgrid based in a community:

- **Determine critical loads:** The first step is to determine the critical loads that are necessary for the community's operation and safety. These could include communication networks, hospitals, water pumps, and emergency services. When it comes to electrical supply, these loads should come first.
- **Sort loads:** Sort the remaining loads into groups depending on the urgency and relevance of each. Residential loads, commercial loads, and non-essential loads, for instance, can all be given the appropriate priority. Take into account elements like the effect on human life, financial ramifications, and communal well-being.
- **Create load-shedding plans:** Make load-shedding schedules that specify the sequence and timeframe for shedding various load categories. Consider issues like peak demand times, neighborhood needs, and the accessibility of alternate energy sources. To minimize annoyance, it's crucial to effectively inform the community about these timetables.
- **Use intelligent load management systems:** To monitor electricity consumption in real time by implementing cutting-edge technologies like smart meters and sensors. Utilize these techniques to identify periods of high demand and balance loads appropriately. This can be accomplished through demand response programs, which provide incentives for consumers to use less electricity during peak hours.

Enable energy backup and storage systems by integrating them into the microgrid in order to store extra energy during times of low demand. When there is a spike in demand or when the main energy source is insufficient, these stored energy reserves can be used. Additional assistance can be offered during emergencies via backup generators or renewable energy sources like solar panels.

In this work, CMGC will decide about the delivery of power to many MGs according to priority using a priority-based distribution algorithm if multiple MGs file a report regarding their power shortage problem to CMGC. Different conditions are analyzed using different case studies. In the case studies, the peak voltage and frequency were 500V and 50Hz respectively for all microgrids involved.

3.1. Case Study I

When a power shortage report reaches CMGC from different MGs which are in different priority levels, the distribution of power to the required MGs as per their priority is shown in Fig. 3. As per Fig. 3, the power shortage report reached to CMGC from four different MGs of which MG_2 is with the highest priority level depending upon its present load and sent a power shortage report of 3kW. After fulfilling its total requirement, remaining power is provided to the second priority level MG which is MG_4. Same action is proceeded with MG_5. However, it will not be possible to fulfill the requirement of forth level MG as no excess power is available with the source MG. The power availability condition is described in Fig. 4.

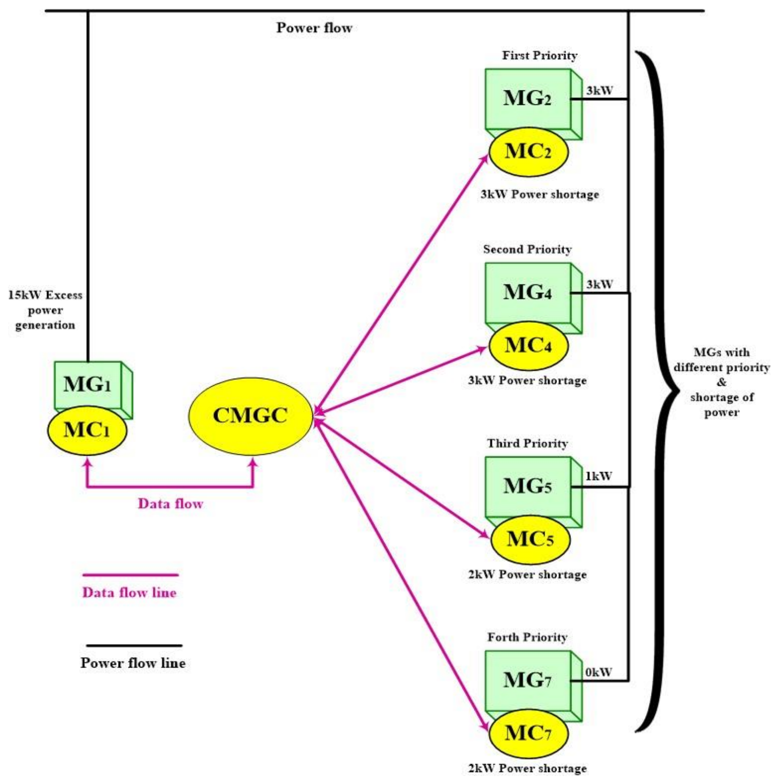

Fig. 3. Priority-based distribution of power.

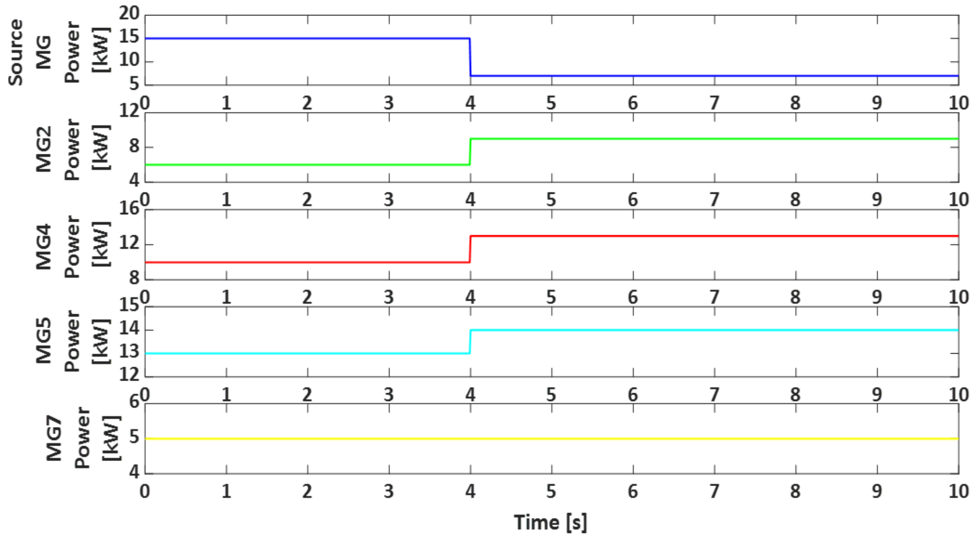

Fig. 4. Simulation of case study I.

Fig. 4 shows the condition of power availability in different MGs. The first MG that is the source MG generating 15kW power of which it is utilizing 8kW and the excess 7kW power can be sent to the community ac bus under the control of CMGC. At the same time, power shortage report comes from MG_2, MG_4, MG_5 and MG_7 to CMGC. As per the priority level, command is sent from CMGC to MG_2, MG_4 and MG_5 for the schedule of power allocated to them. After power sharing with these three MGs, no excess power is present in source MG so no power is scheduled for MG_7. In response to MG_2's claim of a 3kW power shortage, MG_2 will receive 3kW of electricity from the surplus 7kW, with a range of 6kW to 9kW. The 3kW deficit power will be provided to MG_4 (the second priority level), increasing its output from 10kW to 13kW. The report for a 2kW power shortfall is sent by MG_5, the third highest priority level MG. Only 1kW of power is provided to MG_5 because that is all that is available, yet it can produce 13 to 14kW.

3.2. Case Study II

When a power shortage report comes to the CMGC from different MGs which are at the same priority level, then CMGC decides to deliver power to the required MGs equally as shown in Fig. 5.

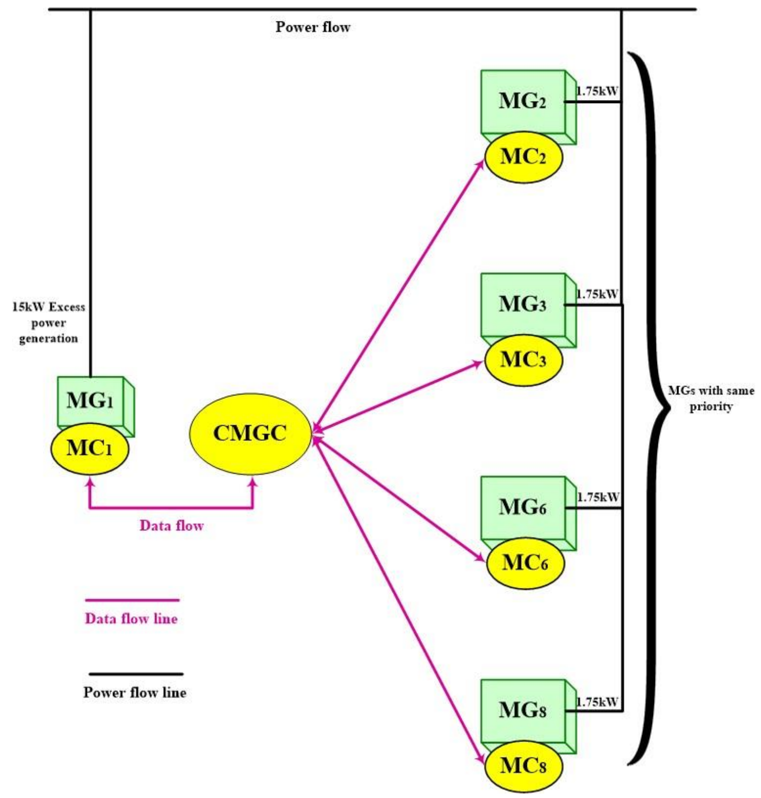

Fig. 5. Power distribution to MGs with the same priority level.

Fig. 6 depicts the power distribution for case study II. Fig. 6 shows that source MG i.e. MG_1 is running with 7kW excess power and sends the excess power to the community bus. At the same time, power shortage reports reach CMGC from MG_2, MG_3, MG_6 and MG_8.

As per priority level, CMGC found that all four MG are in the same priority level so the excess amount of power coming from source Microgrid will be shared equally among the four MGs.

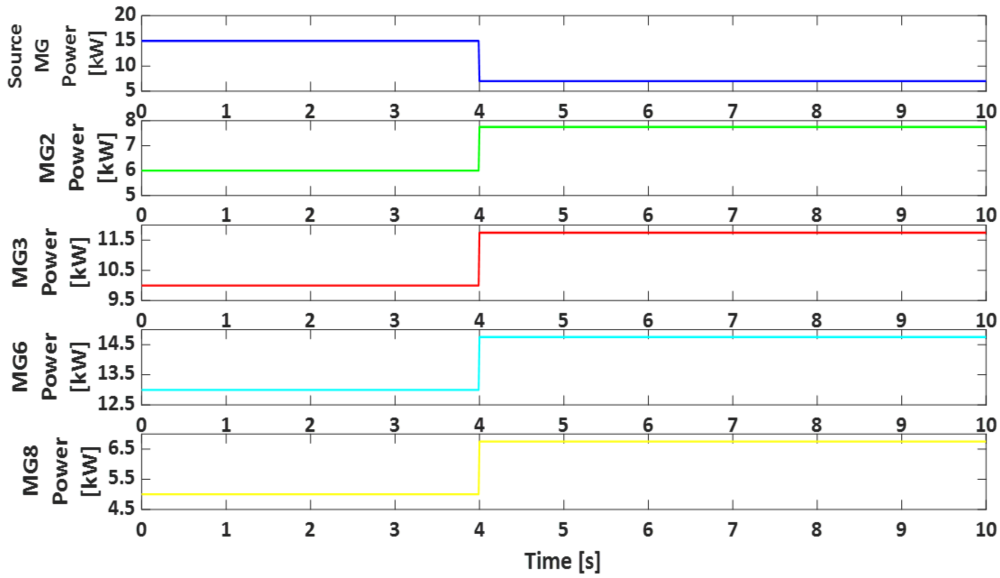

Fig. 6. Simulation of case study II.

3.3. Case Study III

When more than one MG in the same priority sends a power shortage report to CMGC, the distribution of power to the said MGs is shown in Fig. 7. Here, first priority is given to MG_2 and MG_3 as they are at the same priority level. After meeting up their requirements, second priority is given to MG_5 and MG_9. As they are at the same priority level, same amount of power is distributed between MG_5 and MG_9.

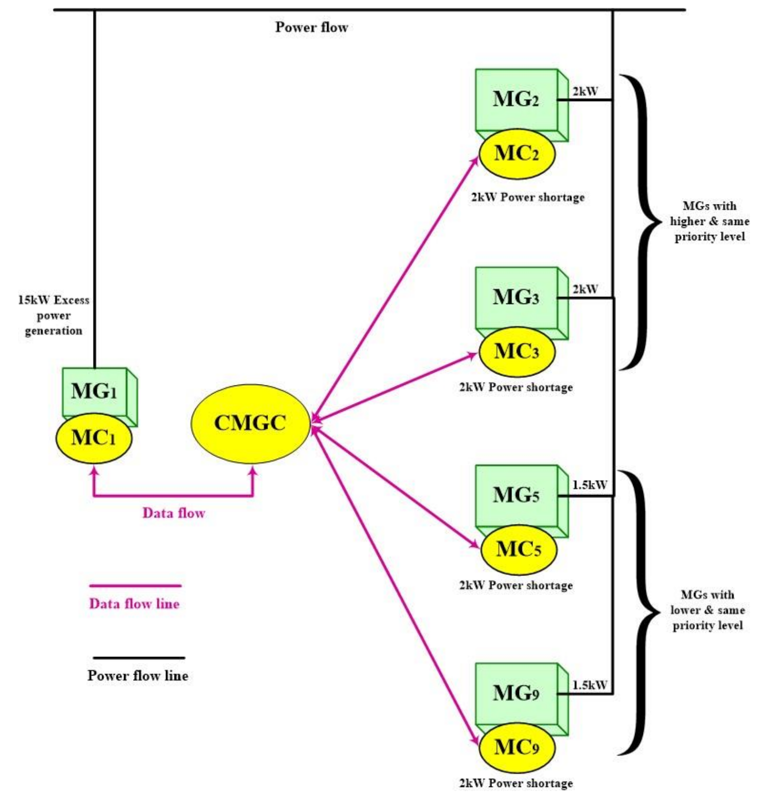

Fig. 7. Distribution of power to more than one MG with the same priority level.

Fig. 8 shows the power drawn by the MGs when excess power is available on the community bus. Fig. 8 represents that MG_2 and MG_3 are in same priority level and each MG have sent request for 2kW power. Also, MG_5 and MG_9 are in the same priority level and send a request for 2kW power from each MG.

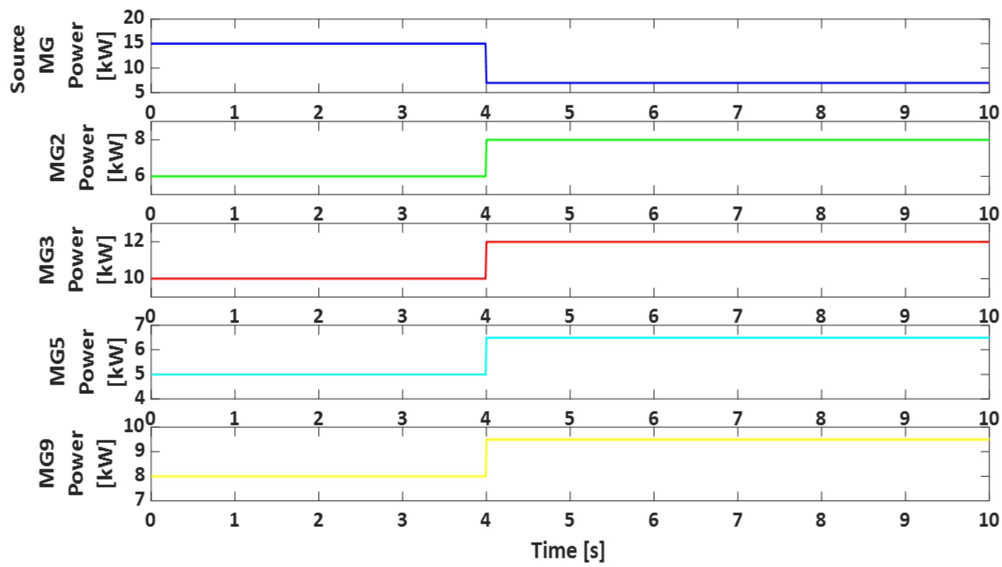

Fig. 8. Simulation of case study III.

As MG_2 and MG_3 are in higher priority level with respect to the other two MGs, their requests are fulfilled first. After delivering the excess power to MG_2 and MG_3, Balance excess power is 3kW and as the other two MGs are in same priority level, thus the remaining excess power will be shared equally with MG_5 and MG_9.

The flowchart of priority-based distribution algorithm is given in Fig. 9.

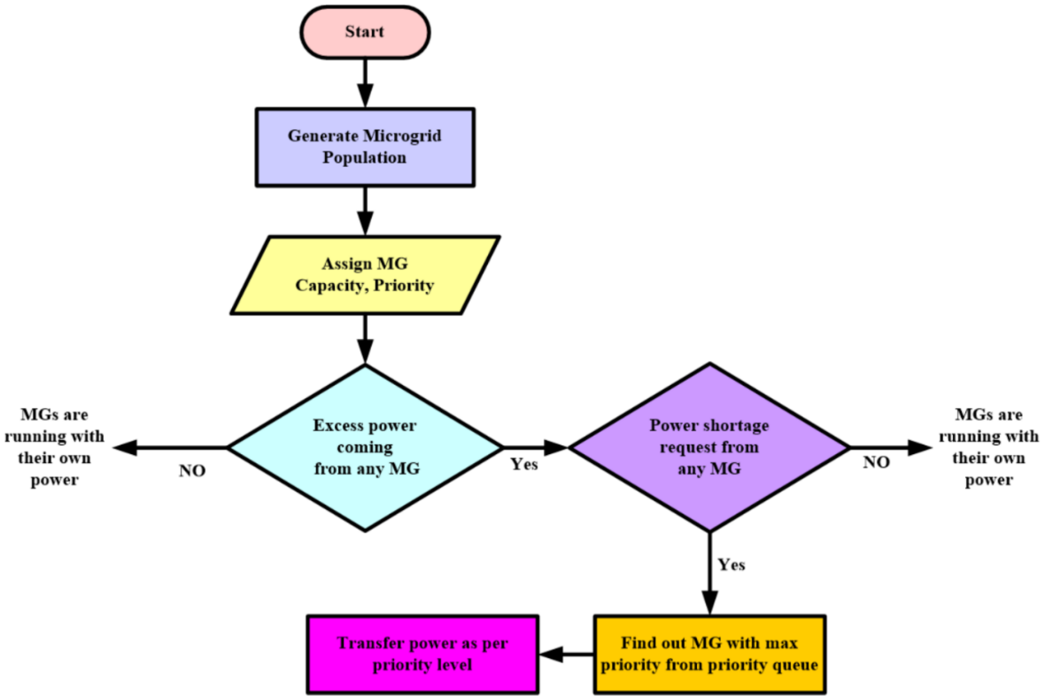

Fig. 9. Flowchart of the priority-based distribution algorithm

4. COMMUNITY MICROGRID SIMULATION AND RESULTS

The simulation cases for a community microgrid's operations are presented in this section and can be seen in Fig. 10.

Here VSC 1 is connected with bus 1 (B1). The VSC is a power electronics converter which needs to be controlled appropriately for use as a microgrid controller for the MG. The VSC 1 together with the Pulse Width Modulator (PWM) controller 1 forms the microgrid controller which maintains the voltage and frequency. One battery is connected with VSC 1 to store electrical energy. The VSC allows bidirectional flow of energy.

The VSCs are generally not directly connected to the bus because the VSC voltage keep on changing depending upon reactive power etc. Thus, a transformer is interposed between the bus and VSCs. The resistance and reactance (for VSC 1 R_0 and X_0 and for VSC 2 R_g andX_g) are equivalent resistance and the leakage reactance of the transformers. Bus 2 (B2) and bus 4 (B4) are the generator bus where generator-1 (G1) and generator-2 (G2) are being connected.

The generators are induction generator. Capacitor banks are provided to each generator for stable generation at no load. As load increases, the MG controller provides the requisite reactive power dynamically to maintain the voltage. Bus 3 (B3) is the load bus where load 1 and load 2 are connected via breakers. For simulation purpose the shaft torque is generated from the rpm by the following equation.

Characteristic of prime mover:

$$T_{sh} = K_1 - K_2 N \quad (5)$$

where K_1 = 2910 and K_2 = 2.

Here VSC 2 is connected with bus 6 (B6). The diode bridge rectifier and the VSC 2 comprises the interlink controller. The resistance and reactance (R_a and X_a) represent the feeder from the microgrid to the interlink controller. The excess power, if any, present in the MG will flow to the community bus from where the excess power will be delivered to the other MGs which are facing a shortage of power problem and had sent report of the shortage power to CMGC.

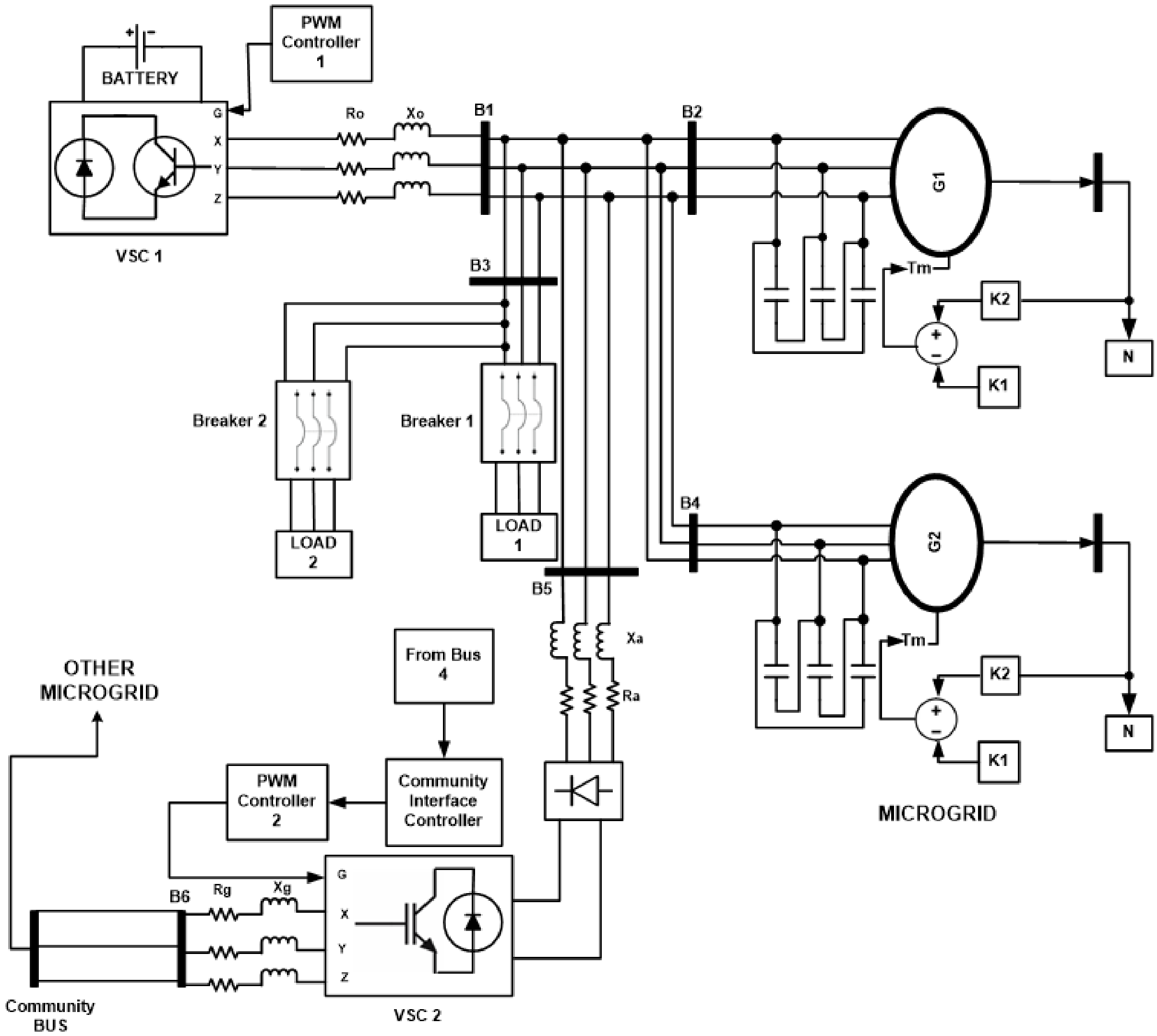

Fig. 10. MATLAB model of the community microgrid.

Figs. 11 and 12 show the operation of microgrid vis-à-vis the generation of excess power, its detection and dumping it on the community bus. The MG controller controls the voltage of the microgrid with the change of load. It shows simulated waveforms of MG operating under different loads while staying within its installed capacity. Generator voltages (V_{XYZ}), generator 1 and 2 currents (I_{XYZ1}, I_{XYZ2}), microgrid controller current (I_{CXYZ}), the simulated waveforms of load current (I_{LXYZ}) of the microgrid, power consumed by the local load (P), power flowing to the community bus (P_{flow}) and generator speed (N).

Fig. 12 represents the performance of the MG as the local load is varied. The installed capacity of the MG is 15kW. At the load bus, an initial 8 kW load is connected to the MG. An excess generation of 7kW on the MG is experienced by the Community Interphase controller, which in turn pushes the excess generation onto the Community Bus. The neighborhood MGs consume this power. This is illustrated by the P_{flow} graph in Fig. 12. This prevents wasting of the MG's extra generation and over-speeding of the generators leading to an increase of the frequency of the MG.

The second load of 7kW is turned on at 0.7s to increase the load to 15kW. There is no longer any excess generation on the MG because its local load is now consuming all of its generation. It is detected by the Community Interface Controller, which turns off the power flow to the Community Bus. The graph's zero value throughout this time period serves as a reminder of this in Fig. 12. By turning off the 7kW load at 0.85s, the burden on the MG is again lowered to 8kW. The surplus generation is detected by the community interface controller, which then allows it to flow to the Community Bus for consumption by the neighborhood MG. This is indicated by an elevated value of P_{flow}. Throughout the simulation, since the load on the MG matches its generation the speed of the generator in the MG represented by N on the graph remains constant at around 1450 rpm.

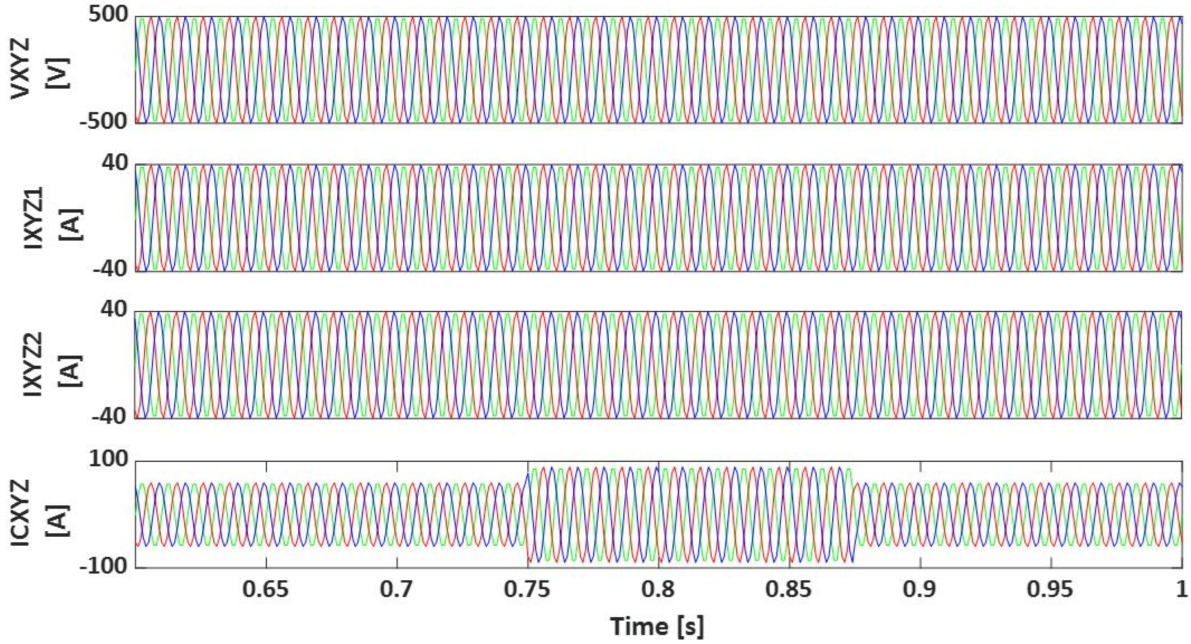

Fig. 11. Operation of the MG under varying load condition.

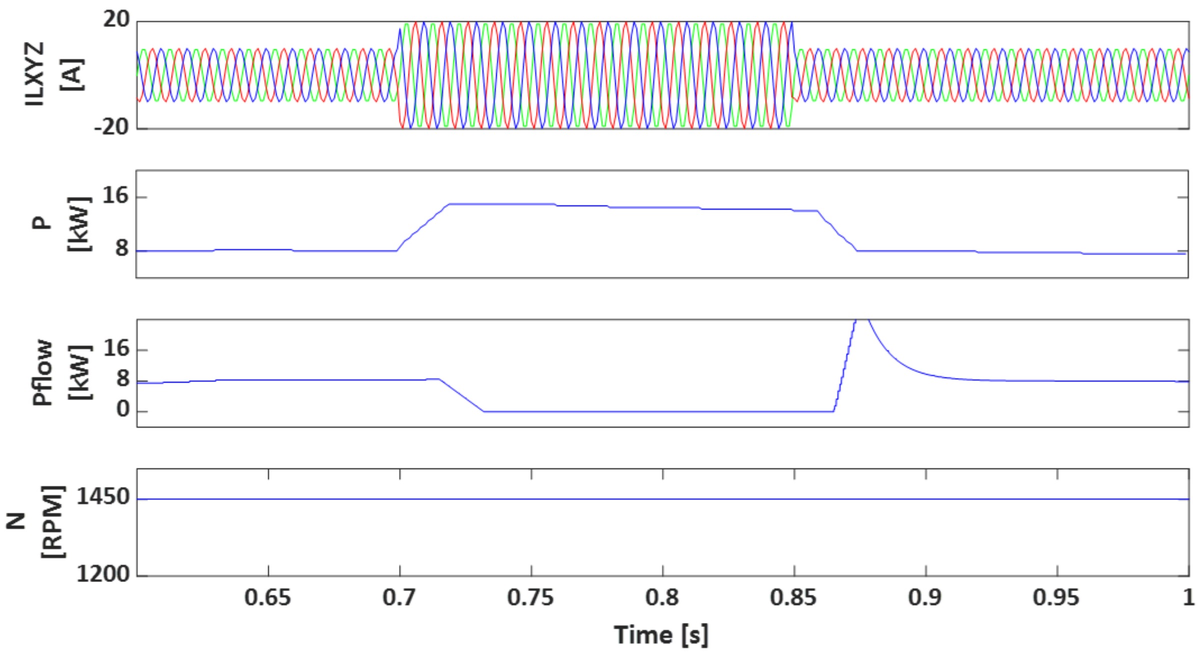

Fig. 12. Performance of the source MG under different load conditions within maximum power capacity.

5. CONCLUSIONS

The microgrids connected to the distribution system of the utility has either to have excess installed capacity (like spinning reserve) or draw excess power from the main grid, when there is a contingency and a need for excess power. This paper presented a concept of Community Microgrid to share the excess power of any MG with the other MGs in the neighborhood over the community bus. Thus, the MGs are spared of buying power from the Main grid at high rate. The exchange of power between the MGs can be on cost sharing basis or for free.

Excess generation of MG is a serious problem resulting in an increase in frequency. This paper put forward a new method of sharing this excess power by using priority-based distribution algorithm with the neighborhood MG and maintaining a full load for its generators. This helps the latter in their contingencies. Furthermore, the MGs do not need to have a full installed generation.

A community microgrid's energy management plan must include a well-thought-out priority-based power sharing algorithm. It improves dependability, contributes to the overall sustainability and resilience of the energy system, and strikes a balance between the community's varied energy needs. The efficacy of a system in managing the fluctuating energy supply and demand in a community microgrid is contingent upon its capacity to provide constant monitoring, feedback, and adaptation.

In order that the adjacent microgrid utilizes the excess power when needed, this article developed a coordination technique for guaranteeing proper power flow from the community bus. As local loads are provided via separate microgrids, and as individual microgrids also offer excess energy to the community bus for other microgrids in the community, the CMG structure would improve the economics and reliability of the community's power supply. Individual microgrids would be able to lower the amount of installed capacity that they may need, which might be a huge advantage in densely populated urban areas.

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