AN OPTIMAL LOAD SHEDDING SCHEME BY HYBRID SOURCES

B.Don Dougles[1] | Dr.D.Sabapathi[2]
[1](PG Scholar, Dept of Electrical and Electronics Engineering, M.P Nachimuthu M.Jaganathan engineering college, Erode)
[2](Associate Prof, Dept of Electrical and Electronics Engg, M.P Nachimuthu M.Jaganathan engineering college, Erode)

Abstract— *Electricity consumption within the world is consistently increasing, creating our lives become a lot of and a lot of captivated with electricity. There are some totally different models planned within the field of power grids. During this paper, we tend to concentration on micro-grids and propose priority-based hierarchal operational management for multi agent-based micro-grids. In this proposed approach by using the different sources the load shedding should be efficiently controlled. If sudden increase in load the power is compensated by using the battery storage system. The long run organization could be a new multi agent-based load cracking theme and multi agent-based classified construction to know such robust micro-grids.*

1. INTRODUCTION

DC power structures are ahead extra and more care in distributed system and micro grids due to their compensations. In energy supply side, many DGs such as photovoltaic, petroleum cells, and sets present natural DC output. Also, in the load's side, several applications such as processors, LED lights, PCs, and electric vehicles are in proofs expected DC loads. Obviously, it is ideal to power DC loads with DC supply. Moreover, DC system has the benefits to deal with inherent issues associated with AC system, like synchronization of the distributed generators, three-phase unbalances, inrush currents, reactive-power flow, and harmonic currents. Nowadays DC micro grids are found in many places and the development technologies of future intelligent DC micro grids are also being deployed for highly efficient combination of circulated generation and up-to-date electronic loads. In this paper, the distributed system consisted of DC living homes. The smart DC living home has been established at Aalborg University, where the ZigBee communication and remote control are deployed. Smart DC distributed power system, integrated together with DGs, controlled loads, energy storage system (ESS), etc., requires to more and more intelligent, economical operation and stability. As the categories of renewable cause's saturation and well-organized and reasonable utilization of resources, there is an idea that TE framework needs to caring in the upcoming power system.

2. STRUCTURES OF DC RESIDENTIAL DISTRIBUTED SYSTEM (RDS)

The RDS mainly consisting of DC living homes integrate the electrical and information Infrastructure, which is exposed in Fig. 1. Every living home equips with a smart meter and Interconnection with the central grid, intelligent CEMS and electrical market. Customers can receive power from both renewable energy bases and the outer grid. Besides, these operators also are willing to inject additional power into the grid to share through TES. The subsequent introduces the most power framework and CEMS.

3. CONTROL AND IMPLEMENT SYSTEM IN THE DC SYSTEM

Apart from the optimization schedule, the DC system is technically suited for providing control reserve allowing tracking the command and short reaction time.

4. ADAPTIVE DROOP MANAGEMENT IN DC DISTRIBUTED GRID (NETWORK)

A class-conscious approach might adopt for coming up with for the system of DC residential system that is identified: primary, secondary, and tertiary management. Converters management relies on the voltage droop management to share power for DGs and be chargeable for trailing DC voltage reference. The secondary management is for removing voltage deviation and reliable operation, the tertiary management is chargeable for the economical and coordinated operation and host grid that associated with transitive energy management. during this work, we have a tendency to principally thoughtful the first management. PV and WT square measure most well-liked to inject most power and operated in MTTP mode, however, the output voltages of DERs in common bus ought to be the priority. The duplex and directional device square measure obligatory to adjective the out voltages through adjective droop loop. The equivalent circuit of voltage droop management for 3 parallel voltage supply converters is shown in Fig. 2.

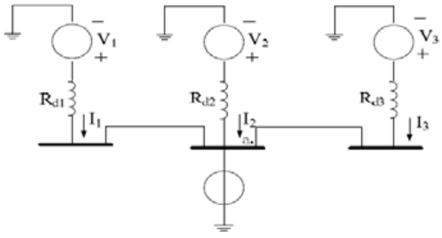


Figure 2. Equivalent circuit of parallel DGs

The Fig. 2 shows the corresponding path of three parallel voltage source converters to accomplish current sharing in distributed way. The output voltage reference of every converter should follow voltage droop characteristic defined with virtual impedance. The grid forming converter in this system can be expressed as

$$v_{o,i} = v_{ref,i} - R_{d,i} \times i_0 \quad (1)$$

$$R_d = 1 / \sum_{i=1}^{n} \frac{1}{R_{d,i}} \quad (2)$$

Where $v_{0,i}$ is the voltage reference of the converter *i*, i_0 is the output current of the converter *i*, $v_{ref,\ i}$, is the orientation voltage of the droop circuit, R_d is the simulated impedance value. For the distributed unit *i* connected with bus, the power generated by unit *i* can be written as

$$P_{DG,i} = v_{o,i} \bullet i_{o,i} \quad (3)$$

The droop circuit in DC power system is converters resistance, so the simulated impedance can be considered constraints. As Kirchhoff's current law and (1), (3), in voltage droop circuit can be written as

$$P_{DG,i} = v_{ref,i} \bullet P_{DG,i} / v_{o,i} - R_{d,i} \bullet P_{DG,i} \quad (4)$$

Where $P_{DG,i}$ is the power of dispatchable unite *i* in the network, $v_{ref,i}$ is the reference voltage of various buses, $R_{d,i}$ is the virtual resistance in voltage droop circuit. According to the signal of the real-time power scheduling, we can program primary control by optimizing the adaptive virtual impedances R_d . Assuming ε is the maximum allowed voltage deviation, which is generally ± 5% deviation, R_d and v_{ref} are designed as:

$$v_{ref} = v_n - \varepsilon / 3 \quad (5)$$

$$R_d = \varepsilon / i_{\max} \quad (6)$$

Where v_n is the output voltage and $i_{\max}$ is the maximum output current. The equations show the equivalent circuit of three parallel voltage source converters. In the processing of schedule, the flop controller equal regulates the voltage situation providing to the internal current and voltage control loops. The every bus voltage should follow the output voltage of every converter every defined with virtual impedance.

5. OPTIMIZATION FOR ECONOMIC OPERATION IN DC RESIDENTIAL SYSTEM COST COMPOSITION IN DC SYSTEM

(1) Cost of utility With the development of bidirectional communication technology in smart grid, the transitive energy between constraints grid and distributed grid can improve the economic efficiency. In other words, customers not only can buy electrical energy from the utility but also sell energy to main grid base on the transactive mechanism. Based on the real-time price observed from the electrical market, operator of DC residential distribute d system could make real-time demand response and optimization schedule. The cost of utility in a control cycle can be modeled as:

$$C_{utility,i} = \begin{cases} f_{buy} P_{utility} \cdot \Delta t_i, P_{utility} > 0 \\ f_{sell} P_{utility} \cdot \Delta t_i, P_{utility} < 0 \end{cases} \quad (7)$$

$$C_{utility}^{total} = \sum_{i=1}^{T} C_{utility,i} \quad (8)$$

Where f_{buy} is the real time price from an electrical market, f_{sell} is the electrical price subsidies for power from DC distributed system to grid, $P_{utility}$ is the power between grid to DC distributed system, which is positive when the DC distributed system absorb energy from the grid, and negative when DC distributed system contribute energy to grid. T is the number of optimization intervals, ΔT_i is the length of i-th time interval, $C_{utility}^{total}$ is the total utility cost in the whole optimization intervals.

(2) Cost of fuel cell The generation cost (except renewable generation) can be modeled by the well know quadratic function of output power as (9), so the cost of the fuel in the system can model as

$$C_F = \alpha P_F^2 + \beta P_F + \gamma \quad (9)$$

$$C_F^{total} = \sum_{i=1}^{T} \left(\left(\alpha P_F^2 + \beta P_F + \gamma \right) \cdot \Delta t_i \right) \quad (10)$$

Where α ,β ,γ are constants, P_F is the output power of fuel cell. ΔT_i is the length of i-the time interval, C_F^{total} is the total fuel cell cost in the whole optimization intervals.

(3) Life loss of BESS In a conservative way, the energy movement can affect the life loss of Li battery. Suppose the temperature is continuous, the association of movement amount L and liberation power E_i in it follows. While the self-discharge/charge is unnoticed, the entire release energy generations to the indicting energy in one movement. In the sense, the life loss in the circulation can be equal to the cost of the BESS. In this work, a cost coefficient is used to build the relationship between the energy circulation and cost of BESS, which is shown in (12) and (13). So the reasonable schedule of charge and discharge power will beneficial to the life of BESS.

$$L = -a \cdot (E_i / E_b) + b \qquad (11)$$

$$C_{bess} = \begin{cases} L \cdot p_{bess} \cdot \Delta t_i, \, p_{bess} \geq 0 \\ L \cdot |p_{bess}| \cdot \Delta t_i, \, p_{bess} < 0 \end{cases} \qquad (12)$$

$$C_{bess}^{total} = \sum_{i=1}^{T} C_{bess,i} \qquad (13)$$

Where E_b the rated capacity of Li storage batteries, the and b is constant are both converters.

When the battery is charging, the value of P_{bess} is positive, or else that is negative. The costs in one period are the sum of i-th

(4) Renewable energy cost Support the customers of the DC residential are the investor of the RES, the cost of REW is free and considered zero. To maximize the REW, the design of the control including MTTP and strategy of operation are economic.

(5) Power Loss the power loss depends on specific cases and detailed information of the system, e.g., the length of cables, various converters, devices and generators. As the control order is implemented by the converters, which are the mainly interdisciplinary of power losses, we can consider the power losses took place in converters devices to evaluating the power loss of the DC residential distributed system, The maximum design value allowed is usually as unit as 10% rating in micro grids. The power losses can be written as following

$$C_{loss}^{total} = f_{buy} \sum_{i=1}^{T} \eta_{ic} \cdot P_{ic} \cdot \Delta t_i \qquad (14)$$

Where the ic η is efficient of the converters, ic P is the output power of converters.

6. OBJECTIVE FUNCTION

The objection of this study is to minimize the total operation cost in 24 hours based on the real-time electrical price, which can be written as:

$$\min C_{system}^{total} = f(C_{utility}^{total} + C_{F}^{total} + C_{loss}^{total} + C_{bess}^{total}) \qquad (15)$$

Where the total cost can be calculated through (8), (10), (13) and (14), which is a nonlinear equation.

7. CASE STUDY

In this section, we present a 6-bus DC residential system model as shown in Fig. 4 to verify the proposed method. The bus voltage standard includes 230 V, 48 V, 24 V and 12 V. Meanwhile, the data of units will be collected and processed through CEMS, which also command the schedule and control.

The prediction generation of WTs and PVs constraints in the appendix Table 1 with the plot is given in Fig. 5. Take a 24 hours real time electrical price from Nord pool electrical market as a case, which constraints in appendix Table 2 with the plot given in Fig. 6. For the minimizing cost objection and the constraints of units real-time in appendix Table 3, the optimization method of a sequential quadratic program makes a lot of iterations to find the optimization results for cost minimization. The optimized power schedule results are shown in Fig. 5. The schedule contains the charge/discharge of ESS and power flow of fuel cell and utility, and also satisfied the constraints. The whole day economic consumption is shown in Fig. 6. The comparison shows that the total cost has been reduced by optimally schedule the resources. The CEMS is responsible for computing the optimized schedule and implement. In daily control operation, consideration of the voltage stability, the adaptive VR for converters of ESS, utility and fuel cell constraints are shown in Fig. 10. Meanwhile, Fig. 11 shows that the voltage vacillation is within the allowable range. The results show that DC RDS can reach the stability and economical level, which will be not the only benefit of customers but also grid.

8. PROPOSED SIMULATION MODULE

The proposed model is shown in the figure 3 and the PV array system with the fuel cell is shown in the figure 4

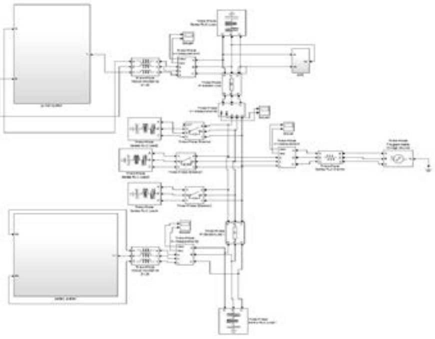


figure 3. Proposed Simulation Model

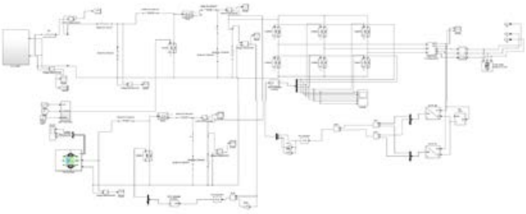
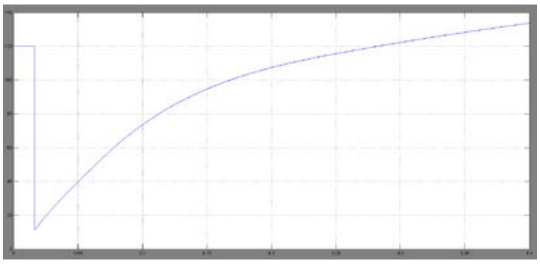
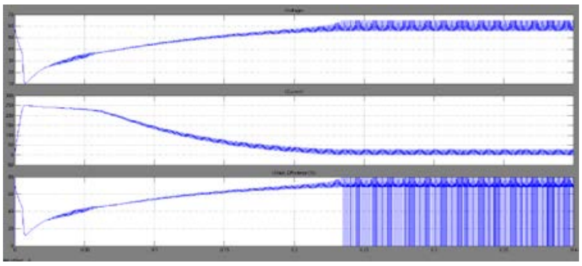


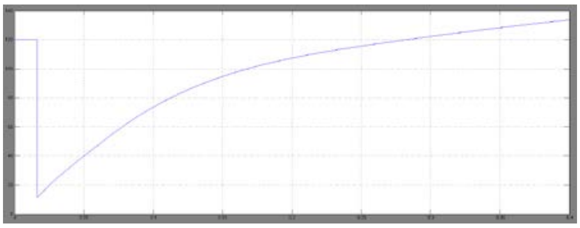
figure 4. PV ARRAY WITH PEMFC



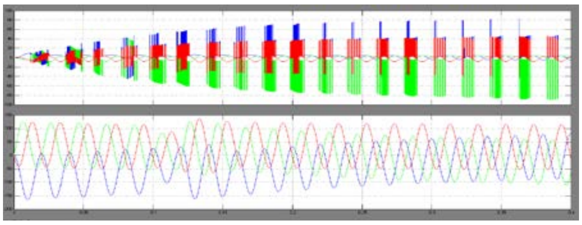
PEMFC



BOOSTED VOLTAGE FROM PEMFC

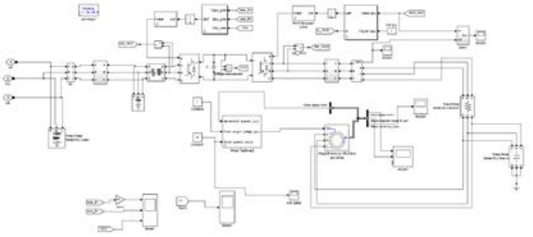


9. OUTPUT VOLTAGE AND CURRENT WAVEFORM OF THE PV SYSTEM

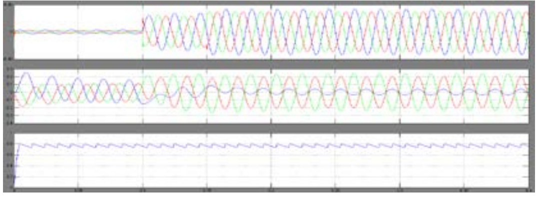


10. WIND SYSTEM

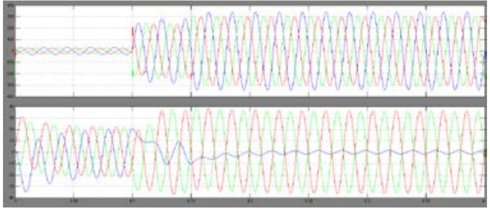
We have proposed the system by including wind system. the simulation module of the wind subsystem is shown below.



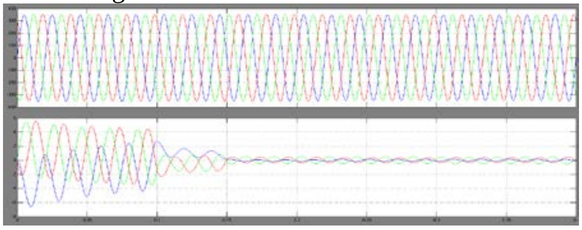
The output waveform of the system is shown below .voltage ,current and vdc.



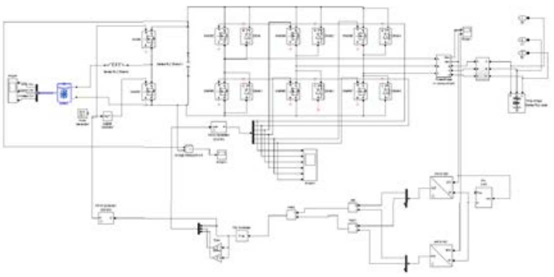
WAVEFORM BEFORE INJECTION IN PPC FRONT END :voltage and current.

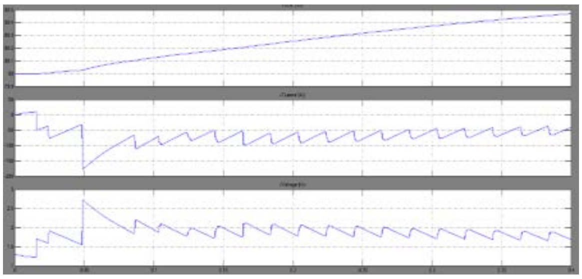


WAVEFORM AFTER INJECTION THROUGH PV AND WIND: voltage and current.

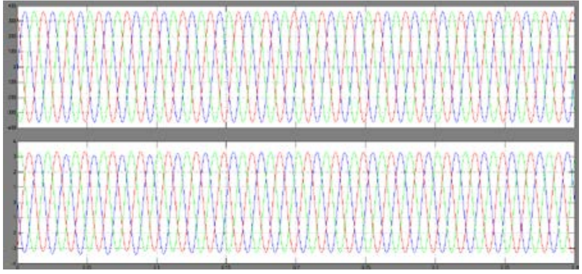


STORAGE BATTERY SIMULATION MODULE





The output waveform of voltage and current after injection is shown below .voltage and current.



So through the proposed system the compensation in the peak time is compensated. The efficiency and the response time are improved.

11. CONCLUSION

As a promising power system, RDS consisting of DC living homes can be managed through CEMS, which is responsible to collected date, predicted, optimizing, control, etc. This work presents a processing of economical schedule and TE with main grid. The work mainly includes economical schedule and stability operation, the mathematic models of main components in this DC power system can be formulated to optimize the power schedule for the objection of cost minimization based on the real-time electrical price, and the results show the optimized hourly power schedule which can reduce the total cost. Meanwhile, a droop control can track the command and control the converters voltage of main units. In the daily schedule processing, the voltage variation is in the keep in stable range, which is benefit to the whole system stability.

In following-up, the precise adjustment of bus voltage and power flow will be evaluated. And the distributed energy management system will be compared with the CEMS. The work will also track to several contents. For example, the thermal and controlled loads will be considered, the optimizing schedule of electrical vehicle in DC system, the resources of DC RDS can also participate in bidding in the competitive electrical market.

REFERENCES

[1] Pararas-Carayannis, G. The Great Tsunami of March 11, 2011 in Japan—Analysis of Source Mechanism and Tsunamigenic Efficiency. In Proceedings of the IEEE/OES OCEANS 2011, Waikoloa, HI, USA, 19–22 September 2011.

[2] Adachi, T. The Restoration of Telecom Power Damages by the Great East Japan Earthquake. In Proceedings of the IEEE 33rd International Telecommunications Energy Conference (INTELEC),Amsterdam, The Netherlands, 9–13 October 2011; pp. 1–5.

[3] Kezunovic, M. Smart Fault Location for Smart Grids. IEEE Trans. Smart Grid 2011, 2, 11–22.

[4] Xu, Y.; Liu, W. Novel multiagent based load restoration algorithm for microgrids. IEEE Trans. Smart Grid 2011, 2, 152–161.

[5] Nguyen, C.P.; Flueck, A.J. Agent based restoration with distributed energy storage support in smart grids. IEEE Trans. Smart Grid 2012, 3, 1029–1038.

[6] Kim, D.-M.; Kim, J.-O. Design of emergency demand response program using analytic hierarchy process. IEEE Trans. Smart Grid 2012, 3, 635–644.