

OPTIMIZATION TECHNIQUES FOR ENERGY MANAGEMENT SYSTEMS FOR SMART GRID WITH RENEWABLE SOURCES

¹S.Sathiya, ²K.Sundararaju, ³N.Thenmozhi

Department of Electrical & Electronics Engineering,

M. Kumarasamy College of Engineering, Karur, India

¹Corresponding author mail id: sathiyashanmugavel@gmail.com

Abstract— Smart Grid signifies a vision of the forthcoming power systems incorporating innovative smart grid technologies, transmission and sharing planes is direction to supply power in smart way. Power system operators having the mission of maintaining the balance between the demand and generation of electric power. Logically more electricity is mandatory when the load is at its greatest value. An essential purpose of a smart grid is the demand side controlling which relieves the force contributor taper the greatest capacity need and allows the customer to reduce the operational cost, aiming to operate the system with increased sustainability. The objective of this project is to present the consignment flowing practice for request side administration of smart grids which handles a huge figure of controllable campaigns. The Energy managing is demonstrated as an optimization problem whose solution is obtained by using an Evolutionary Algorithm and renewable integration

Keywords — *Scattered energy resource, generation scheduling, consignment flowing, smart grid.*

1.INTRODUCTION

Smart Grid (SG) is a theory gives expansion about the conviction in the domains of power-driven setting. It signifies the unification of reckoning, computerization and communicate skills applied on the observing, control and preservation of electric system in a way that fits possible the supply of electricity with major value, capability, safety and reliability [6][13]. However, whirling this concept into somewhat practical requires alterations in the current system, as for example, the setting up of sensors, real-time communication equipments, data handling centrals and also changes in the energy commercialisation process[1].

Several of the important appearances of a smart network are purchaser pleasantness, slave evidence, self-healing reluctance to accept beside physical and radio-dynamic attacks, capacity to put up all forms of production and depotstar choices, market based energy capable operation and extraordinary energy quality and the main functions of Smart Grids are inspire clienteles [5] Participation, supply major quality power, integrate different types of power production and repository as well as contributing a greater participation of the market. Reliability, price savings and power freedom are the various advantages of smart grid network [7].

A. Motivation for Research

With the increased growing demand for energy, utilities tend to develop their generation capacities according to peak loads rather than average power in order to meet the customer's demands. Unfortunately renders power systems highly under-utilized and customer's consumption patterns increasingly irresponsible [13]. Also it has driven utilities to make huge long-term investments in new generation plants which are maximum and typically based on conventional energy sources, such plants – in addition to being capital intensive – lead to increase the amount of Greenhouse Gases(GHG) emissions that majorly affect the earth's temperature, producing in turn changes in weather conditions[8].

In mandate to distract from underexploited schemes and mark the best use of the accessible produced energy without requiring to install new stations, produced capabilities essential to be used further well and excessive attention must be taken to optimally dispense accessible assets[11]. The easiest, freshest and harmless approach to growth the counterpart between need and stock is to set up demand side management live out on countless level of loads, moreover by dropping the need or rearranging the consignment summary. This can be done with the help of demand side control.

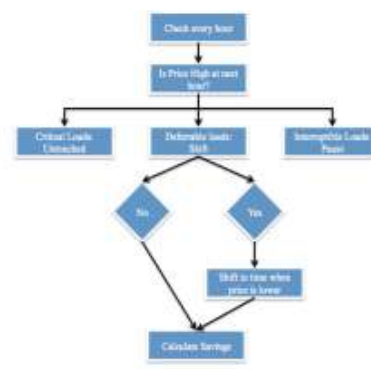


Fig 1.1 Flow Chart of DSM

B. Energy Management System

Energy Managing is a vital function in power administration of the smart network, which delivers provision headed for smart network capabilities in several parts such as power bazaar control and administration, structure constructions and control of regionalized power resources.

The objective of the proposed project is to develop a Demand Side Management (DSM) algorithm [10] which reduces the peak electricity consumption in consumer's side and managing the operation of their appliances according to utility controls and consumer's preferences, that improving demand load profile.

Demand side controlling modifies customer's power ingestion configurations to yield the preferred fluctuations in the capacity of energy dissemination structures [12]. Demand side controlling attentions on applying energy tradable technology, power fares, economic enticements,

and management strategies to moderate the greatest capacity need as a substitute of expanding the production capability or redeveloping the spread and delivery linkage.

Demand Side Handling Techniques

- Peak Clipping
- Strategic Growth
- Dale Filling
- Flexible Load Shape
- Load Shifting
- Strategic Conservation

X-axis=Time (Hours) Y-axis=Power (kWh)

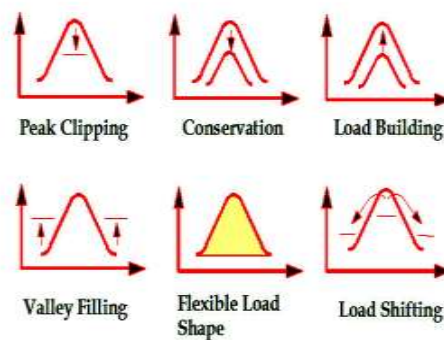


Fig.1.2.Techniques of DSM

2. Consignment Shifting Techniques for Capacity Management

Consignment Shifting is a technique that shift the demands in the topmost hours to the moldy peak hours. It can be cut peak demand at specific periods, ease the need for installing additional power plants and the operation costs of power stations. It is a Technique with Direct control on equipment or through tariff. Load shifting is one of the most traditional means for load management

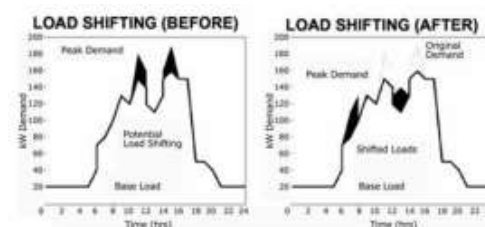


Fig 2. Load shifting Before and After

2.1. Response Side Organization Strategy

This paper elaborates the global day-ahead request side supervision technique on behalf of imminent smart grid. Here, the central system controller of the clever grid customs consignment shifting as its major move. The Objective of DSM could be minimizing the peak load demand, exploiting the use of renewable energy resources and refining profitable welfares.

Rendering to the suggested style, the response side scheme gets the impartial consignment curve as an contribution and processes the essential consignment switch movements so as to satisfy the required capacity ingestion. The DSM is carried out in the beginning of each day which naturally tends to be the predefined control period. Formerly, the switch actions are done in actual interval based on the obtained solution. Figure 2.1 shows the offered style for the day-ahead response side organization technique. It demonstrations the give-and-take of evidence amongst the each piece of equipment and request side organization organizer throughout the concurrent operation. This revenues help of the communication capability of the smart grid.

At any time the ON knob of a device is forced, the joining call is delivered to the smart grid switch. The smart grid switch reactions built on the outcomes of request side management strategy that was done previously. The answer is may be the joining legalized or a novel joining interval.

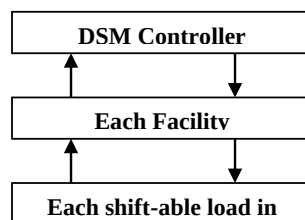


Fig 2.1. Proposed Architecture for DSM

3. Problem Formulation

The offered demand side management policy agendas the joining instants of individually shift-able scheme in the arrangement in a mode that conveys the shipment ingesting arch by means of adjoining as to the detached shipment ingesting curve.

$$\text{Minimize } \sum (Pload(t) - objective(t))^2 \quad \dots\dots (3.1)$$

$$Pload(t) = Forecast(t) + Connect(t) - Disconnect(t) \quad \dots\dots (3.2)$$

Where Detached (t) the value of the detached is arch at phase t, and Pload(t) is the concrete ingesting at time t. The Pload (t) is given by the Equation (3.2).

Everyplace Forecast (t) is the forecasted intake at interval t, and Connect (t) and Disconnect (t) are the entire of loads connected and disconnected at interval t individually throughout the capacity shifting.

Connect (t) is prepared of binary parts: the boost in the capacity at interval t, owing to the linking times of devices lifted to interval t, and the growth in the shipment at interval t owing to

the scheme links booked aimed at intermissions that head. The Connect (t) is given by Equation (3.3).

$$\text{Connect}(t) = \sum_{i=1}^{t-1} \sum_{k=1}^D X_{kit} \cdot P_{1k} + \sum_{i=1}^{t-1} \sum_{j=1}^{t-1} \sum_{k=1}^D X_{kij(t-1)} P_{(1+i)k} \quad \dots\dots (3.3)$$

Where X_{kit} is strategies of form k that are lifted from phase step i to t, is the figure of scheme categories, P_{1k} and $P_{(1+i)k}$ are the power intakes at phase steps 1 and (1+i) correspondingly for gadget kind of k, and j is the entire spell of ingestion for device kind k.

In same way, Disconnect (t) also be made up of of binary parts: the decline in the capacity owing to interruption joining intervals of gadget are remained initially made-up arise their intake at time step t, and the decline in the consignment because of interruption happening at joining periods of gadget are remained predictable to go ahead their ingesting at period follows t. The Disconnect (t) is given by the Equation (3.4)

Everyplace, X_{ktq} is the sum of strategies of kind k that are postponed since interval step t to q, m is supreme tolerable interruption.

This diminution tricky remains focus on behind checks. The sum of strategies lifted cannot be a undesirable significance that is shown in Equation (3.5).

$$X_{kit} > 0 \quad \forall i, k \quad \dots\dots (3.5)$$

Quantity of strategies lifted left from a interval step cannot be further the mass of strategies existing for governor at the interval step that is shown in Equation (3.6)

$$\sum X_{kit} \quad N_{t=1} \leq \text{Ctrlable}(i) \quad \dots\dots (3.6)$$

ctrlable(i) is the quantity of strategies of form k existing for governor at interval step i.

4. Result And Discussion

This project focusing on Residential area for Demand response. We consider Residential area for load shifting.

In Residential area we have No.of devices for power consuming. Here we are going to shift the some of the device from topmost load time to least most time. The Residential Devices are mentioned in the above.

Table 4.1 Residential Devices

Device Type	FIRST HOUR	SECOND HOUR	No. of Devices
Dryer	1.2	-	189
Dish washer	0.7	-	288
Laundry machine	0.5	0.4	268
Rotisserie	1.3	-	279
Iron box	1	-	340

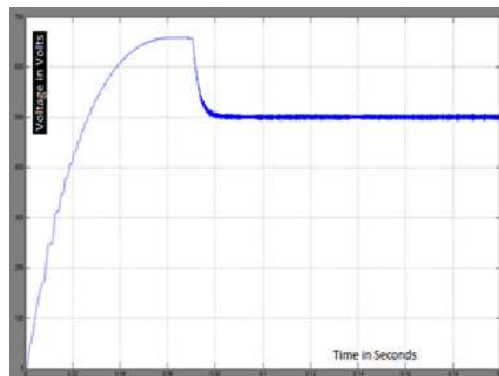


Fig 4.3 Wind Plant Production

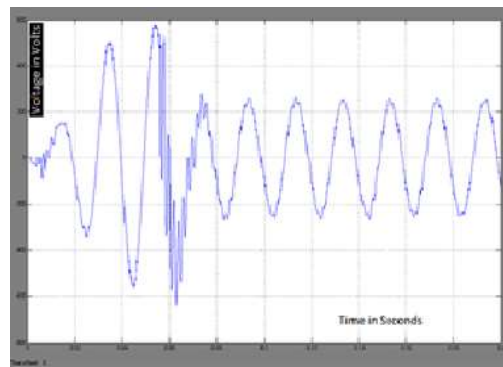


Fig 4.4 inverter output

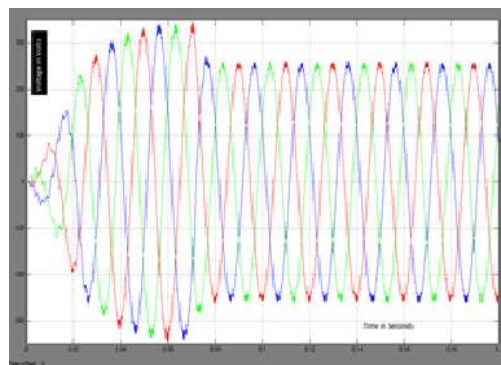


Fig 4.5.Overall System Production

The output waveform which is shown in the above figure, having the facility of changing the load from one phase to another phase according to the load connected with the feeders based on the demand in Residential Areas.

In all the three phases more over the load will be sharing equally based on load shifting technique. These loads can be any one of the components used in the residential areas like Washing Machine, Refrigerator, Coffee Maker, Induction Stove, Light, Ceiling Fan, etc.,

Normally within the fraction of milli-seconds, the system output is set to 230 v for single phase and 415v for three phase supply.

There will be no more overloading in any of the phases also for entire day the power supply will be monitored and saved from the peak demand.

5. Conclusion

The traditional System disadvantages are overcome by using Load shifting Techniques, also Customers are scheduled based on Power Generation in the Generation Station, Due to Load shifting selected components are shift from Heavy Load Consumption time to Low Load Consumption time in all the three phases more over the load will be sharing equally based on load shifting technique. Different Renewable Sources are installed in Consumers Side areas this type of Process will change the Tradition system in to Smart Grid System.

REFERENCES

- [1]. T. Logenthiran, D. Srinivasan, A. M. Khambadkone, and H. N. Aung, "Scalable multi-agent system (MAS) for operation of a micro grid in islanded mode," in Proc. Joint Int. Conf. PEDES & Power India, Dec. 20–23, 2010, pp. 1–6.
- [2]. T. Logenthiran and D. Srinivasan, "Short term generation scheduling of a micro grid," in Proc. TENCON IEEE Region 10 Conf., Jan. 23–26, 2009, pp. 1–6.
- [3]. T. Logenthiran and D. Srinivasan, "Management of distributed energy resources using intelligent multi-agent system," in Multi-Agent Applications with Evolutionary Computation and Biologically Inspired Technologies: Intelligent Techniques for Ubiquity and Optimization, S-H. Chen, Ed. et al. Hershey, PA: IGI Global, 2011, pp. 208–231.
- [4]. T. Back, D. Fogel, and Z. Michalewicz, Handbook of Evolutionary Computation. New York: IOP Publ. and Oxford Univ. Press, 1997.
- [5]. A. I. Cohen and C. C. Wang, "An optimization method for load management scheduling," IEEE Trans. Power Syst., vol. 3, no. 2, pp. 612–618, May 1988.
- [6]. D. P. Kothari, Modern Power System Analysis. New Delhi, India: Tata McGraw-Hill, 2003.
- [7]. C. W. Gelling's, Demand-Side Management: Concepts and Methods. Lilburn, GA: Fairmont, 1988.
- [8]. K. H. Ng and G. B. Sheble, "Direct load control-A profit-based load management using linear programming," IEEE Trans. Power Syst., vol. 13, no. 2, pp. 688–694, May 1998.
- [9]. T. Logenthiran, D. Srinivasan, and A.M. Khambadkone, "Multi-agent system for energy resource scheduling of integrated micro grids in a distributed system," Electr. Power Syst. Res., vol. 81, no. 1, pp. 138–148, 2011.
- [10]. I. K. Maharjan, Demand Side :Load Management, Load Profiling, Load Shifting, Residential and Industrial Consumer, Energy Audit, Reliability, Urban, Semi-Urban and Rural Setting. Saarbrücken, Germany: LAP (Lambert Acad. Publ.), 2010.
- [11]. Y. Y. Hsu and C. C. Su, "Dispatch of direct load control using dynamic programming," IEEE Trans. Power Syst., vol. 6, no. 3, pp. 1056–1061, Aug. 1991.
- [12]. Venkatasubramaniam & Karthikeyan, R., "Monitoring of Transmission Line Parameters Using Wireless Networks in Smart Grid" IEEE Spectrum, Digital Library, ICICA 2014, PP 330-334
- [13]. K.Sundararaju,A.Nirmalkumar,2011, Control Analysis of STATCOM with Enhanced method for compensation of Load Variation", European Journal of Scientific Research,Vol.53, No.4,PP.590-597.
- [14]. K Sundararaju, AN Kumar, AN Kumar, S Jeeva, 2014, "Performance analysis of STATCOM in real time power system", 2014 International Conference on Advances in Electrical Engineering (ICAEE), pp 1-4.

