

DESIGN OF SMART MAXIMUM DEMAND CONTROLLER FOR PEAK LOAD MANAGEMENT FOR DOMESTIC LOADS -application of DSM Tool

Dr. P Ravi Babu ¹, P Satya Krishna ²

¹ Professor in EEE Dept, SNIST, ravi.dsm@gmail.com

² Student in EEE, SNIST, pvsskv@gmail.com

ABSTRACT

Energy is one of the most important and essential source of life for the mankind. Among all types of sources, Electrical Energy is basis for development in any society or nation. In India substantial and sustained economic growth is creating enormous demand for electric energy. To meet the demand, many electrical power generating plants were installed, yet the gap between demand and supply has been continuously growing. A Way to overcome this problem in the present scenario is to utilize the existing sources as optimally as possible, limiting the wastage in the usage of electric energy.

In this paper, an Attempt is made to propose a methodology to solve this critical problem through load management during peak hours, in the case of domestic loads. This will help in bringing the supply within the range of demand; in such a way that the consumer and the utility will be benefitted simultaneously.

The paper also presents the application of DSM techniques to domestic loads, where the power consumption can be optimized during peak hours; hence the reliability of the power supply can be increased. The proposed maximum demand limiter is a part of demand side Management. The results are presented to show the effectiveness of the proposed method for load management.

Key Words: : Demand Side Management (DSM); Load priority techniques (LPT); End use equipment control (EUEC); Peak clipping valley filling; Differential Tariff (DT)

1. INTRODUCTION

The most essential and non compensating form of energy is electric energy which keeps the nation's wheel on growth and economy to prosper. It has been a significant resource for all nation building activities. The demand for electricity is on ever increasing side due to increase in demand from domestic, commercial

and industrial ends. Coming to the domestic load demand, it has increased tremendously due to increase in the standard of living of the people and also with the rapid advancement of technology which include the usage of modern electronic gadgets which demand lot of power. As the generation of electric power is not able to keep pace with the growing demand, the gap between the generation and consumption of power is inevitable. To balance the system, the conventional solution is to cut the power during the peak hours. According to survey state governments like Karnataka and Andhra Pradesh, is spent crores rupees on the purchase of electricity every year from other neighbouring states, more ever which is temporary solution for the problem. The permanent solution to overcome this problem is to use the present available electric power with better efficiency and adopt power management and energy conserving techniques in order to reduce the overall consumption of electrical energy. The load problems can be overcome by control over the usage of electrical loads during the peak hours by fixing the priorities to the loads with respect to time. By this load control approach we have two advantages: this reduces the burden on the supplier and also the need of purchasing electricity from the other states can be postponed (which is a temporary solution for the problem), the permanent solution to pacify the problem partially can be achieved by monitoring the usage of non vital sources during power crisis hours.

This can be achieved by adopting load priority techniques, a member of DSM Technique, to control the loads automatically during peak times instead of load shedding. This methodology can be applied to domestic loads which can assure results in terms of continuous supply and reduction of load demand during peak hours. It is not only in the interest of the utility but also for the consumers as well the efforts are made to control the demand during peak periods and level the load curve as much as possible. However the

support of the customers plays a vital role in this process.

A new model called direct load control based on DSM Techniques are adopted, a hardware and a software model have been developed which shows the promising results to control the electrical load during peak hours along with playback period.

II. PROBLEM STATEMENT

The major problem in the current scenario is power cuts to domestic and commercial consumers. The conventional solution to the problem is either increasing the generation to match the load or curtail the loads i.e. load shedding. This problem can be overcome by innovative Demand Side Management (DSM) techniques.

A. LOAD SHEDDING

Power systems require constant and prudent management of supply to meet the demand. At all times there must be sufficient supply to meet the demand, but electricity demands is not consistent because of the peak periods, when the demand is higher and due to the increasing number of customers requiring electricity services. Load shedding mainly refers to cutting down the power supply in some area to limit the asking demand rate and to balance the system. If proper care is not taken, the scaling demand can even lead to blackouts.

When power is inadequate, power companies can either increase the power generation or reduce the demand during peak times to balance the system. Power companies normally take a sequence of steps to keep the system stable and to avoid power cuts. Scheduled load shedding is controlled by way of sharing the available electricity among all its customers. Load shedding schedules are drawn up in advance to describe the plan for switching off parts of the network in sequence during the days that load shedding is necessary.

B. DOMESTIC LOADS

Domestic loads are amount of energy spent on the various appliances used within housing. The amount of energy used per household varies widely depending on the standard of social life style of the country.

C. LOAD FACTOR

The load factor refers to load curve with peak and off peak hours and cost of unit of energy. The load factor is most typically

calculated on a monthly or annual basis. When a customer violates the maximum demand limit on the system, that customer will be penalized with heavily. The prime intention of the penalty is to discourage the consumer not to violate maximum limit of power during the peak hours. The prime focus of penalty is to limit the maximum demand for better load factor; hence this reduces the overall cost per unit of energy. As the load factor can be defined as the ratio of Average load to Maximum demand.

$LoadFactor = \frac{Average\ Load}{Maximum\ Demand}$

III. PROPOSED METHODOLOGY

Consider a middle class family for this case study. The loads details of a middle class family in India are mentioned in table.1. The electric power consumption during crisis hours is mostly in the morning from 6 am to 10 am and 6 pm to 10 pm in the evening. It is required to control the power loads i.e. Non vital loads like Air conditioners, Geezers etc, during these hours. This mechanism is automatically done with help of maximum demand limiter. This can be successfully implemented with DSM techniques like load priority technique. The power usage during the peak hours is limited by curtailing non vital loads and hence, this will cause reduction in demand on supplier

The prime objective of the proposed work is design of a Maximum Demand Limiter model for domestic load management during peak hours. Fig.1 shows the hardware model design of Maximum Demand Limiter. It is assumed that there are 8 typical domestic loads in house; these loads are categorized with priority number based on the need. The fig.1 reveals details of the hardware model for controlling the loads, with the help of electromagnetic relay. The MDL mechanism which curtails the non vital loads when the demand exceeds the pre defined load limit during peak hours. The detailed operation mechanism of the maximum demand limiter is given below. The circuit diagram shown in fig1 has a Current Transformer (CT), amplifier, comparator and electromagnetic relay. The secondary of the CT is connected to comparator through amplifier and the comparator output signal drives the electromagnetic relay based on the load conditions. Figure.1 shows the working hardware model of Maximum Demand Limiter

for load management and the typical loads data of the domestic consumer is shown in table1.

investments on new power plant projects and minimizes power purchase from neighbour states.

The maximum demand control can be achieved by sensing the load current with help of CT. This CT is also called as I to V converter. The primary of the CT is connected various types of consumer loads, based on the variation in the

primary current of the CT, this causes the change in secondary CT signal for suitable action (Turn ON / OFF the non vital loads).

IV. RESULTS AND CONCLUSION

The objective of the Maximum Demand Limiter (MDL) is reduces the power cuts by curtailing the power supply to the low priority loads during the peak times. After implementation of the MDL at domestic consumers premises say, it is able to control non vital loads during the peak hours; hence there is fall in demand by 20% due to low priority loads. Fig. 1 shows the typical load curve of a domestic consumer and Fig. 2 shows the load curve after successful implementation of DSM based MD controller for load control during peak hours. Fig.3 Shows the Working Module of the Maximum Demand Limiter [MDL] Fig.4 shows the status of the loads during non-peak hour Fig.5 reveals the operation of the MDL of curtailing the supply to the non-vital loads during peak hours Fig.6 whenever the consumer fails the pay his monthly bill the MDL curtails the power to the consumer loads irrespective of its priority.

The proposed methodology assures the reliable power supply to the domestic consumers by facilitating the power supply to only the basic loads like lighting and fans during the peak hours / power cuts. This provides great reduction in peaks in the load curve during peak load hours and influences the considerable improvement in the load factor. In this work, an intelligent hardware system called Smart Maximum Demand Limiter is designed for controlling the domestic loads, which provides minimum power supply for the basic loads during the electrical energy shortage hours. Hence, with this we can achieve continuous power supply to all domestic consumers and great relief in MD to the supplier during peak hours along with better load factor. It also permits to achieve postponement of capital

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Tables and Figures

Table 1 Domestic load

Si. No	Load Type Load	Load rating (kW)	Number
1	Fridge	0.48	01
2	A\C	1.8	01
3	Oven	1.2	01
4	Geyser	2.5	02
5	TV\Music system	0.1	01
6	Computer	0.46	01
7	Motor Pump	0.4	01
8	1 Mixer	0.65	01
9	Wet grinder	0.6	01
10	Fans	0.2	04
11	Tube light	0.25	06
12	Exhaust fan	0.1	02

Figure 1: Typical load curve

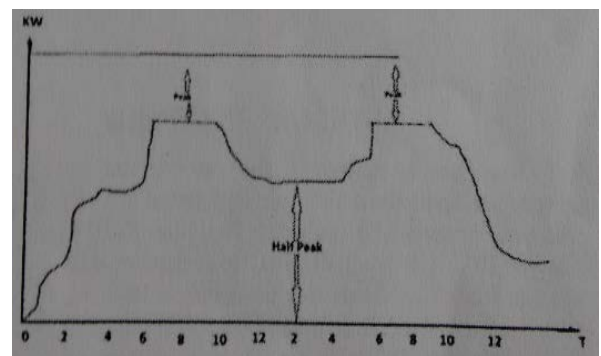
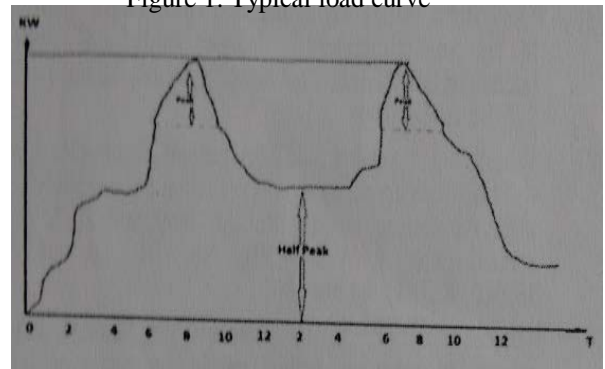


Figure 2: Load curve after DSM tool

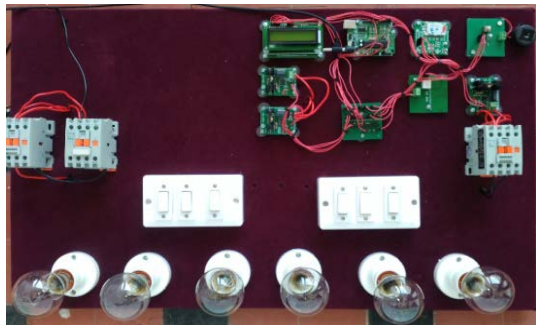


Figure 3: Outlook of the Working Model



Figure 4: Position of Load during Off Peak Hours

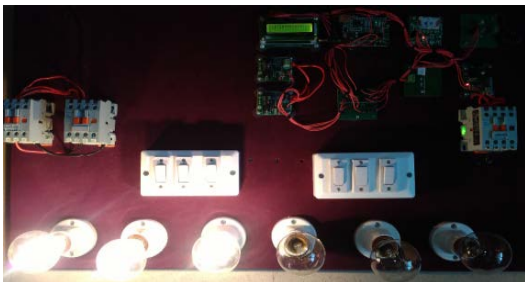


Figure 5: Position of load during peak hours



Figure 5: Position of Load during Bill Due

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