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Review of Demand Side Management by using Artificial Neural Network

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ABSTRACT

This paper present the performance of maximum utilization electrical energy by using demand side management. Load management in feeder is very important term to understand to stable load curve for stability of load curve we have to manage the demand. For managing the load (demand) we use demand response. This paper is to provide a facility by which we can control power supply of all appliances connected to the feeder. Actually the problem of surrounding occurred is that the continuously fluctuations in load within a day. Sometimes, in a day it is maximum and sometimes it is too low. Due to which generation or supply side cannot fulfill all these load demands within a day. The main objective of this paper is the maximum utilization of energy by developing the load shift algorithm. The optimum utilization of electrical energy is need of the time and for that in this paper we are using load technique under demand side management for minimizing the load at a peak time and utilize the unutilized loading valley time. The basic Demand Side Management programs peak clipping, load shifting, load addition. In this system we are using the Artificial Neural Network (ANN) technique to manage the demand side. It is a self decision making system which also use for bidirectional communication. We present a simple accurate system to manage electricity load with ANN.

Keywords—Demand side management (DSM), Load shift algorithm, demand response, Artificial neural network (ANN).

I.INTRODUCTION

Load Management introduced in 70's, is aimed to reduce the operating cost of the electrical power network. In our power system the problem occurred is that, there is a continuous fluctuations in load within a day. In some hours in day the variation occurred in load is maximum and sometimes it is too low. Because of this generation or a supply side cannot fulfil all these load demands within a day. For this, sufficient utilisation of electrical energy is a need of time. In this paper for the maximum utilisation of energy we are using load techniques under demand side management (DSM) for minimising the load at peak time and utilise the unutilised load in off peak time.

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Usually, the basic aim of demand side management is to encourage the consumer to use less energy during peak hours, or to move the time of energy use to off peak times such as night time weekends. Peak demand management does not decreased total energy consumption, but could be expected to reduce the need for investments in a networks or power plants.

The demand side management (DSM) programs include some following methods by which we can easily know that how we can utilise the maximum energy.

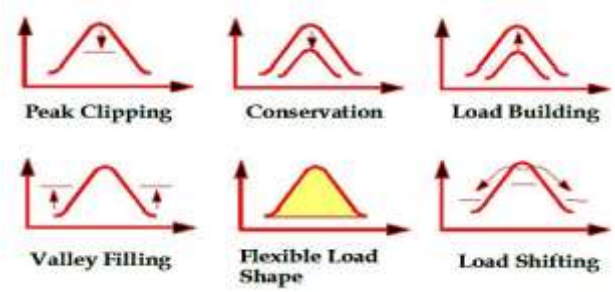

Fig. 1 Methods of demand side mamagement programs

A. Peak clipping

Peak clipping is the reducing system peak loads at exact or definite periods. This is a typical form of energy management. It involves the reduction of energy consumption for the limited period of the day. This can defer the need for additional demand and total consumption of energy.

B. Valley filling

Valley filling is form of load management that gives the information about the building of off peak loads. If such case occurs where there is a underutilized capacity then that time it can operate on low cost fuels. With this we can get the increase in total energy consumption but there will be no increase in peak demand. A typical example for the creation of valley filling is the energy thermal storage.

C. Load shifting

Load shifting is the shifting of load from on peak time to off peak periods. With this we can found the decrease in a peak demand, but there will be no change in a total energy consumption. A typical methods used for load shifting are the time-of-use (TOU) rates or the use of storage devices.

D. Strategic conservation

Strategic conservation is the reduction in end-use consumption. It gives the reduction in both peak demand (depending on coincidence factor) and total consumption of energy. Example of strategic conservation is appliances efficiency improvement and building energy conservation.

E. Load building

Load building is basically the increase in overall sales. The output of load building is an increase in a both peak demand and total energy consumption. Examples of load building include electrification, commercial and industrial process heating and other means for increase in energy intensity in industrial and commercial sectors.

F. Flexible Load Shape

Flexible load shape involves the variations in reliability or quantity of service. In place of influencing load shape on permanent basis, the utility has another option to create a obstacle in loads when necessary. Which then cause some reduction in peak demand and little change in total energy consumption.

G. Energy efficiency

Energy efficiency can be stated as the use of less power to perform the same tasks. This includes the permanent reduction of demand by using more efficient appliances such as water heaters, refrigerators, or washing machines which can further help us in proper use of energy.

H. Demand response

Demand respose is the any respective orpreventative method which helps to reduce, flatten or shift load demand. Till now demand response programs have focused on reduction to differ the high cost of constructing generation capacity. However, now-a-days demand response programs are being looked to assist with changing the net load shape as well.

I. Dynamic demand

Dynamic demand can be explain as advance or delay appliance operating cycles by a few seconds to increase the diversity factor of the set of loads. By monitoring the power factor of the power grid, as well as their parameters, individual, intermittent loads would switch on or off at a particular moments to balance the overall system load with generation, reducing critical power disturbances. As this switching (on/off) would only advance or delay the appliance operating cycle by a few second, it would not be noticeable to the end user.

II. OPERATION OF DSM

Electricity is one of the main issue in our day to day life. Depending on the current variations electricity demand gets affected and it becomes difficult to fulfil this demand on time. So it is important to manage demand side for the customer requirement. This paper gives the idea that how we can manage the demand side by using load shifting method with the help of artificial neural network (ANN) technique.

ISSUES

- Argument on demand-side management is that has been ineffective because its output is in higher utility costs for consumer and also the less profit for utilities.

- One of the main aim of demand side management (DSM) is consumer should be charged according to the true decided price of utilities at that period. If consumers are using less electricity during off-peak hours and more electricity during peak hours then thus achieving the main goal of demand side management the consumer should be charged for it.

Here the distribution system is considered with the source of 33KV and the step down transformers. The system is having the four feeders each having 11KV capacity. Feeders are namely Paloti, Gavthan, Medical and Savangi. By analysing all the requirements and the data of the distribution system the parameters are fed to the basic simulation model. Then the output graphs are observed and we come to know that where the load should be shifted according to the peak period and the off peak period obtained from the graph. The neural network is then trained according to the ranges whatever the limits we have to put. The trainer is further applied to the feeders. It will show where the over loading is occurred and also where the load can be shifted. In this way we can use artificial neural network technique for load shifting method to manage the demand side.

In our analysis we consider the distribution system model shown in figure 2.

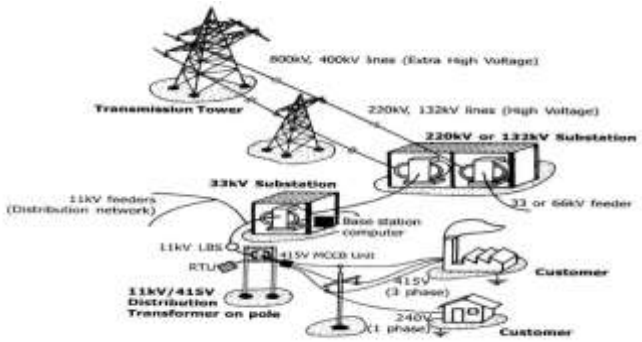

Fig. 2 Distribution system model

The analysis of total energy sale as per the all areas like residential, agricultural, commercial, etc. is shown in table 1.

Table1. Customers Percentage Energy Sales

Category	Energy Sales
Residential	16%
Agricultural	39%
Commercial	5%
Others	2%
Small Industries	10%
Medium Industries	15%

Large Industries	13%

DSM PROGRAMS

Demand Side Management is basically the planning, analysis and implementation of utility activities to study and fulfill the customer's load demand. Implementation of a load shaping options as a load management, strategic conservation, and selective load growth can results in a efficiency in a a resources we use and also reduced cost to both the customer and the utility side. The Electric Power Research Institute (EPRI) has a recently sponsored several studies to document the lessons learned from the experienced of utilities demand side management (DSM) programs. [1]

Generally, load management can be classified into following sections direct load control (DLC), which allows the utilities to shed remote customer loads; indirect load control, which allows customers to control their loads independently according to the price, signal send by the utilities; and local energy storage which allows the both utilities and customer to store energy during the off peak time where the cost is low and consume during the on peak time where the cost is high. [2]

The most important problem occurred with electric power industry today is energy efficiency. This happened due to the power quality disturbances which are transients, interruptions, under voltage, over voltage, waveform distortion, voltage fluctuations and frequency variations. On minimizing this disturbances efficiency can be easily improved. Many electric utilities have to deal with such a problems as high cost for a new plant and decreases in financial performance. In addition, the public has become increasingly concerned with environment and rising electricity prices. These prices issue also can be improved by DSM programs.[3] DSM has step up towards the promising technique to implement DSM due to its ability to effectively convince comsumer to shift their peak time energy consumption to off peak time. Which results into, consumers would prefer to consume more energy during off peak times rather than on peak times in order to decrease their energy cost. [4]

Demand management is not profound concept. When energy is expensive or the grid is approaching peak capacity, utility can simply shut down the power. It happened in California it called rolling black outs. For manage the power we have to reduced demand on grid, it is not easy and it is costly also.[5] But it can be possible by using this load shifting technique using artificial neural networks.

Peak-load shifting is the process of mitigating the effects of the large energy load blocks during a period of time by advancing or delaying their effects until the power supply system can readily accept additional load. The traditional intent behind this process is to minimise generation capacity requirements by regulating load flow. If the load themselves cannot be regulated, this must be accomplished by implementing energy storage systems (ESSs) to shift the load profile as seen by the generators.

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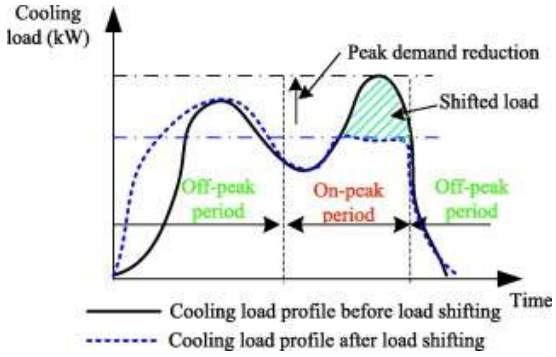

Fig 3. Load shifting curve

Depending on the application, peak-load shifting can be referred to as "peak shaving" or "peak smoothing". The ESS is a charged while the electrical supply system is powering minimal load and the cost of electric usage is reduced, such as at night. It is then discharged to provide additional power during periods of increased loading, while costs for using electricity are increased. This technique can be employed to mitigate utility bills. It also effectively shifts the impact of load on the system, minimising the generation capacity required.

Load shifting is not a new concept and has been implemented successfully by numerous industrial and large scale commercial facilities in the past to decreased electrical peak demand and associated with low energy costs. With the rapid expansion of renewable energy plants in recent years, peak-load shifting has received noteworthy attention, and for the different reasons than in the past. The unwanted fluctuations in power generated by renewable energy sources can be detrimental to maintaining the transient and dynamic stability within the system.

ARTIFICIAL NEURAL NETWORK (ANN)

What is ANN:- The artificial neural network is a computational model based on the structure and functional same as that of the biological neural network that constitute animal brain. The information flows through network on the structure ANN because the changes on the neural network or learns, sense is based on the input and output.

HISTORY OF ANN

The first artificial neuron was produce in 1943 by the neurophysiologist Warren McCulloch and the logical Walter pits. The people are concentrated in the symbolic side of artificial neural intelligence. Only 80s scientists saw that the real potential of neural network.

TYPES OF ARTIFICIAL NEURAL NETWORK

There are six types of artificial neural network.

1. Feed forward neural network
2. Radial basis functional neural network
3. Kohonen self-organising neural network

4. Recurrent neural network
5. Modular neural network
6. Physical neural network

Here, we are using the feed forward back propagation neural network.

Why we are using the feed forward neural network?

- The feed forward is the simplest type in all neural network.
- To solve linear separable problem. We can use in more than one perceptions.

There are three layers in artificial neural network

Input layer :- this is the first layer of neural network and to provide the input data or feature to the network.

Output layer :- this is the layer which gives to output of the predictions. This layer use to activation function is different for different problem for example binary classification problem; we want the output to be either 0 or 1. This layer are also use to sigmoid activation function.

Hidden layer :- a feed forward network is applied to a series of function to the input. We having multiple hidden layer, we can compute complex function by cascading simple function. This is also use the binary classification problem.

III. RESULTS

Demand side management programs are organise in different countries for saving the energy and also increase in the efficiency.

A. Mexico

In Mexico some programs are created for the energy conservation and for energy saving. First is "Comision Nacional para el Ahorro de Energia" (CONAE) i. e. National commission for energy conservation. This program was created in 1989 for the conservation of energy. Second is Fideicomiso para el Ahorro de Energia Electrica"(FIDE), i.e. Trust for Electric Energy Saving, this program was created in 1990. CONAE is a localised to the Mexicons public developed program in 2005. CONAE included in six sector programs, they are federal public administration, state owned companies, state and municipalities, big private companies, small and medium size companies and social sectors and the three programs related to DSM are standardization, transport and distributed generation.

Sector programs includes different activities in every year such as the annual awards for FPA, energy conservation and energy studies. This programs also carried reduce fuel consumption, utilisation of renewable energy sources, sector programs also include activities like promotion of energy saving, spreading the awareness

for energy conservation, training for energy saving. FIDE focused on carrying out energy efficiency actions directed to users in the industrial, commercial, domestic and municipal, service sectors.

FIDE financially support the electric energy saving project give technical help to the development and give training about energy saving also provide financial support to the industrial sector that replace the inefficient equipment.

B. Brazil

The "programa Nacional de Conservation de la Energia Electria" (PROCEL) ,i.e. National program for electricity conservation operates since 1985 and "Programa Nacional de Racionalizacion del Uso de 10s Derivados del Petroleo y del Gas Natural"(CONPET), i.e. National Program for the Rationalization of the use of oil and Natural Gas operates since 1991. PROCEL operates for the electricity conservation and efficient use of electric energy. Occupation, Sanitation, education, industry, buildings, public lands, municipal energy management and public lighting, these are comes under in PORCEL.

CONPET has the main objective is to encourage the consumer for renewable energy sources and efficient use of energy in residential, commercial, industrial and agricultural sectors and also promote the customer the use of non renewable energy sources like petrol, diesel and promotion in the use of natural gases and the natural sources as a fuel.

IV. CONCLUSION

Load shifting results in efficient system and improvements in consumer requirements also the energy cost can be minimise. Similar improvement in reliability and presents a practical opportunities to proceed with effective peak clipping. When load shifting is applied, the energy clipped at the peak hours is utilized in the valley hours. The load in the valley hours is relatively low and the lower load periods do not contribute significantly to system reliability indices. There is a more improvement in system reliability when the load shifting is applied to bus load and then applied to the one customer load sector. This is expected as load shifting applied to the bus load results in more energy shifting.[6]

It is relevant to mention that the World Energy Council, provides a very good guide for emergence of effective national DSM programmes, which would be followed by interested countries, and it can be presented in step wise format:

1. Create awareness of the relevance and benefits of DSM between all actors within the Energy sector
2. Also aware the people about DSM by advertising and publishing posters.
3. Establishing a national entity responsible for Energy Efficiency
4. State clear and measureable targets
5. Define a strategy in order to achieve the national goals in EE
6. Developing an implementation plant
7. Monitoring, reviewing and evaluating the implementation programs and targets

8. Continued improvement

Finally, the authors consider that Latin America are still lacking of the two major pillars of DSM programs, which are the long term political commitment and the statement of clear and measurable targets of energy use. However, a more enthusiast interest in DSM is growing rapidly in the region and positive results can be expected.[7]

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