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A Review on Forecasting Electricity Load Demand

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Abstract: In today world, load forecasting is very important for the power system operation. The meaning of Load forecasting is to predicting the future load with the help of historical load data available. For the Power system management scheduling and dispatching operations load forecasting plays an important role and it also concerns the prediction of energy demand in different time spans.

Keywords: Load forecasting, random disturbances, different techniques, Weather factors.

I. INTRODUCTION

Load forecasting helps an electric usefulness to make important selection including selections on purchasing and generating electric load, load switching, and infrastructure development. The meaning of Load forecasting is to forecast the future demand with the help of historical load data available. Load forecasts are highly important for energy suppliers and other participator in electric energy generation, transmission, distribution and market. The accurate forecasting of the load is an essential element in power system.

II. CLASSIFICATION OF LOAD FORECASTING

The classification of load forecasting can be considered as spatial forecasting & temporal forecasting. [3]

A. SPATIAL FORECASTING

The future load distribution in a particular region, such as a country, or a state, or the whole country is called the Spatial Forecasting.

B. TEMPORAL FORECASTING

Forecasting load for a special supplier or collection of consumers in future hours, days, months or even years is called Temporal Forecasting and it can be divided into four types –Very short term load forecasting, Short term load forecasting, Medium term load forecasting and Long term load forecasting.

(b.1) Very Short term Load Forecasting- A forecast load from a few second to several minutes are called Very Short-Time Load Forecasts (VSTLF). A Very short-time load forecasts, integrated with the information about scheduled wheeling transactions, generation cost, transmission availability, spot market, energy pricing, and spinning reserve requirements inflict by an independent system operator, are used to determine the best approach for the utility resources. Very short-time load forecasts is used in Generation, Distribution schedules & Contingency analysis for system security.

(b.2) Short term Load Forecasting- In Short term load forecasting, forecast load a period of one week. It is used in economic load scheduling, Scheduling of spinning reserves at generating stations and Better maintenance of generating equipments etc. Short term load forecasting is essential for unit commitment, security analysis, economic allocation of generation, maintenance schedules.It also used inLess Green House Gases emission, Economic load scheduling, efficient utilization of fuels in thermal plants, optimal hydro-thermal co-ordination.
The another application of STLF is to give the system dispatcher with more recent instruction that is up -to- date forecast with the recent weather forecast and random action taken into account and it also predictive evaluation of the power system security.[4]

(b.3) Medium term Load forecasting – In case of Medium term load forecasting time span is 1 to 12 months. It is also required for scheduling fuel supplies and maintenance action which require a lead time of few days to several weeks. Medium term load forecasting is used in determining the capacity of generation, transmission or distribution system expansions and Planning for seasonal peak winter and summer.

(b.4)Long term Load Forecasting- LTLF covers a time span of 12 months to few years. In the system planning,

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restriction and management of power distribution companies the long term peak load demand projections have an important role. The accuracy of the long term load forecasting has significant effect on developing future generation and distribution planning.[5]Long term load forecasting is used in generation and distribution planning.

III.FACTOR AFFECTING OF POWER SYSTEM LOAD

The total power system load is the sum of all the consumers' load at the same time. Various factors that affect the system load behaviour, which can be classified into the following categories:

- Weather
- Time
- Economy
- Random Disturbance

a. Weather: "The atmospheric conditions existing over a short period in a particular location is called weather". Weather is the most important factor for load forecasting. Climate is change with time: seasonally, annually and on a decadal basis. The change of the weather causes the change of consumer's comfort feeling and in turn the usage of some appliances such as space heater, water heater and air conditioner, cooler etc. Some Weather factors are:

- Temperature
- Humidity
- Precipitation
- wind speed
- Cloud covers and light intensity and so on.

Temperature: "The part of hotness or coldness of a body is called Temperature". The Previous days temperature is also affect the load profile. During summer season, there is a high positive correlation between temperature and load and during winter, there is a negative correlation between temperature and load. This means that during summer increase in load due to increase in temperature and decrease in load due to decrease in temperature, will result is not only average daily load but also lower the peak demand, But in winter decrease in per degree temperature will results in increase of electric load. High temperature can increase not only the resistance of the transmission lines, but also it can change the reactance of line, due to temperature induced expansion of the length of transmission line. [6]

Humidity: Humidity is also an important factor, because it changes the human being's comfort feeling greatly. The amount of water vapors in air is called humidity. Normally humid air was called not just the moist air but was specified as the mixture of water vapors and other component of air and humidity was defined in terms of water contents of this mixture called the absolute humidity. Humidity can increase apparent temperature while it has no effect on the real temperature. At high humid atmosphere the rate of evaporation through skin (perspiration) is lower than it would be under normal conditions. Since human perceives rate of transfer of heat rather than temperature itself, so we feel warmer at high humid conditions. Thus humidity can increase the feeling of the severity of temperature and make people to use more cooling appliances therefore due to this fact daily load curve will show high value during humid day. [7]

Precipitation: "The quantity of water fallen on earth at a specific place in a Specific Period of Time is called Precipitation" and it can also be defined as, "The amount of snow, rain or hail fallen at a specific place within a specific period of time." Precipitation is expressed in inches or centimeter of water. Precipitation can also affect load consumption directly and indirectly.

1) Direct effect - Heavy rain or snow can make people to stay home and it can cause darkness also. So due to the fact that people will be forced to stay in door they will consume more electricity for lighting purpose and for entertainment appliances.

2) Indirect effect - By indirect effect we mean that heavy rain or snow can decrease the temperature thus may have positive or negative effect on load consumption. By negative we mean load consumption will increase and by positive we mean decrease in load consumption.

In summer effect of precipitation is positive because temperature will decrease and become pleasant so less AC and other cooling appliances will be used by domestic consumers. In Abbottabad town rain in summer even in the month of June can often make the weather so pleasant that people do not feel need to use even fans, so due to precipitation load will decrease dramatically in summer and hence precipitation is considered an important factor for next hour load forecasting(very short term load forecasting).[8]

In winter season the effect of precipitation is negative because it can decrease the temperature and can further intensify the severity of cold weather. Therefore due to extensive use of electric heater during rain a sudden peak will arise. Snow in winter or even rain in winter decrease temperature; reasonably and also make people to stay in door causing more power used for heating purpose and lighting the room. So for short term load forecasting precipitation factor must be considered to accurately predict the load and if not considered the predicted load may be wrong by huge margin thus causing huge loss for the power company (in case of over generation in summer)

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or may result in load shedding (in case of under generation).

Cloud Cover and Light Intensity-

Load consumption depends upon the height and thickness of clouds and the time of the day. In short term load forecasting, cloud cover is ignored because of the high and thin cloud has very little impact on temperature especially at night. The effect of cloud cover on load consumption depends upon the height and thickness of clouds and the time of the day. The high and thin cloud has very little impact on temperature especially at night so it can be ignored for Short term load forecasting. The effect of cloud on temperature is the net effect of the following three things. [11]

1) Green house effect of clouds
2) Reflection of the sun light from top of cloud
3) Reflection of the thermal radiation of earth from cloud back to the surface.

Since the effect of cloud on load consumption depends upon time of the day. At night there is no sun light so cooling effect of cloud cover is zero. So at night cloud has green house effect as it traps heat in to the atmosphere, and it also reflects the thermal radiation from earth back to the surface and hence has net warming effect. Thus cloud cover at night can increase temperature significantly also the next day temperature will be high. So during summer next day load will be very high. The green house effect of the cloud reflects only 50% of the outgoing radiation but on the other hand reflection of thermal radiation is about 90%. So at night thermal reflection of cloud plays more important role in warming up the atmosphere then the green house effect. During day time reflection of sun light from the top of the cloud called albedo (90%) dominates the green house effect of clouds which is only 50%. And thus during day clouds have net cooling effect. So load consumption during a cloudy day will be low due to low temperature. The cloud cover not only has impact on the temperature but also it can affect the light intensity at day time. If clouds are thick then it can block most of the sunlight, forcing the consumers to use electric bulbs etc even at the day time to light their houses, thus increasing the consumption of electricity. So for short term load forecasting we should consider not only the effect of cloud cover on temperature but also its effect on light intensity to forecast next hour / next day load more accurately.[12]

b. TIME - In short term load forecasting, time is the most important factor because its impact on consumer load is highest. The load curve has Different property; "time of the day" "day of week", "week of month" and "month of season" property. This means that load curve is periodic in nature. Load demand reflects the consumer's daily life style. At mid night everyone is sleeping so there is no use of lighting or heating the house, so load becomes least. Similarly at 8 pm everyone is at home watching TV, sitting beside heater, and cooking work etc, so load is highest at that part of the day.

The consumer's daily life activities can be classified in to three categories:

1. Working Time
2. Leisure Time
3. Sleeping Time

The load curve has two peaks one in the working time and one in the leisure time, while at sleeping time load curve shows least value. The rule of load variation discussed above is not the only rule. There are certainly other rules of load variation with time. For example weekend and national holiday load is observed to be lower than the week day loads due to the absence of factory and office loads. The start of semester of universities or school year also has the significant impact on load consumption and thus changes the load profile. It is noticed from the collected load data that the load curve is periodic. This periodicity of load occurs not only in the daily load but periodicity is present in weekly, monthly and seasonal and yearly load curves. This is very important property of load curve because by taking periodicity of load in to account we can predict or forecast load more effectively.

c. ECONOMY- On the system average load and system maximum demand, economic factors such as price of electricity, management of load policy and degree of industrialization have a significant impact. With the development of modern electricity markets, the relationship between electricity price and load profile is even stronger. The price of electricity is different in all types loads (commercial, residential, agricultural and industrial). [13] Economic factor has more important in long term load forecasting. To manage the load, some countries electricity is cheaper at night than at day. Economic factors such as electricity price, management of load and degree of industrialization have a powerful impact on system average load and system maximum demand. Thus economy of the state has also an impact on the usage of electricity. Economic factor has also impact the load curve for short term load forecasting. Price of electricity and the people's purchasing ability also have effect on the consumption of electricity, hence more costly the electricity is, less it will be used by the domestic consumers. Most population of India is non affordable the air conditioner. The daily load curve is also affected by price of electricity. Time of use pricing can change the time span and the time of event of peak load. In most of the country's electricity is cheaper at night than the day. Thus by doing that night valley for fitted because people

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incline to use electricity for heating equipments at night and during day needed to use stored heat for warming the rooms and homes etc. Therefore time of use pricing can make domestic as well as industrial consumers to adjust their load and thus helps in peak shaving and filling of the night valley. [14]

d. RANDOM DISTURBANCE – The power system consists of different types of consumers for example domestic, agricultural, industrial etc. The overall load of domestic consumers shows good statistical rules and is periodic in nature, but on the other hand industrial and agricultural loads are highly inductive and start up and shut down of such type of load induce huge spikes to the load curve. These spikes are called the random disturbance because start up and shut down of these huge loads is quite random in nature and there is no way to predict the occurrence of these spikes. CNG station load also lies in this category. Special events such as National and Religious celebrations also are another source of random disturbance. Diwali, Holi, Eid, Christmas and other religious events such as Dashehra, are the examples of the special events. Similarly, a world cup football match, Pakistan Vs India Cricket match also lies in the category of special days and is another source of random disturbance, causing a huge spike in the load curve due to increased usage of TV and cannot be accurately predicted because we do not know how much TV will be used during that day. Other typical events include strikes and government compulsory demand side management due to predicted shortfall of electricity. In the modern power system is composed of numerous electricity users.

Although it is not possible to predict how each individual user consumes the energy, the amount of the total loads of all the small users shows good statistical rules and in turn, leads to smooth load curves. This is the groundwork of the load forecasting work. But the startup and shutdown of the large loads, such as steel mill, synchrotrons and wind tunnels, always lead to an obvious impulse to the load curve. This is a random disturbance, since for when the data from such a load curve are used in load forecasting training, the impulse component of the load adds to the difficulty of load forecasting.

IV. CONCLUSION

Factors affecting the load forecasting have been reviewed in this paper. Different techniques have been applied to load forecasting. (1) multiple regression, (2) exponential smoothing, (3) iterative reweighted least-squares, (4) adaptive load forecasting, (5) stochastic time series, (6) ARMAX models, (7) fuzzy logic, and (8) artificial neural networks. There is also a clear move towards hybrid methods, which combine two or more of these techniques After surveying all these approaches, we can observe a clear trend toward , hybrid forecasting techniques.

REFERENCES

[1] Study of Short Term Electric Load Forecasting of 132/33KV Maiduguri Transmission Substation using Adaptive Neuro-Fuzzy Inference System (ANFIS) by Idakwo O. Harrison Department of Engineering University of Maiduguri Teaching, Hospital. Dan'isa, A. Dept of Electrical Engineering Bayero University Kano and Bello Ishaku Department of Engineering University of Maiduguri Teaching, Hospital, International Journal of Computer Applications (0975 – 8887)Volume 107 No. 11, December 2014.

[2] Fuzzy Logic Methodology For Short Term Load Forecasting by Patel Parth Manoj M.E. Student, and Ashish Pravinchandra Shah Assistant Professor, Electrical Engineering Department, Parul Institute of Engineering and Technology, LimdaWaghodia, Vadodara, India. IJRET: International Journal of Research in Engineering and Technology eISSN: 2319-1163 | pISSN: 2321-7308 Volume: 03 Issue: 04 | Apr-2014.

[3] Short-Term Load Forecasting Based on Adaptive Neuro-Fuzzy Inference System by Thai Nguyen E.ON-U.S, Lexington, Kentucky 40507 U.S.A. and Yuan Liao University of Kentucky, Lexington, Kentucky 40508 U.S.A. Journal of Computers, VOL. 6, No. 11, November 2011.

[4] Development Of Models For Short-Term Load Forecasting Using Artificial Neural Networks by SimanekaAmakali Cape Peninsula University of Technology 11-1-2008.

[5] Short term load forecasting using fuzzy logic by PritiGohil Post Graduate student, Monika Gupta, Assistant Professor MEFGI, Gujarat technical university, Rajkot, IJEDRCP1402026 International Journal Of Engineering Development And Research (Two Day National Conference (RTEECE-2014) -17th ,18th January 2014).

[6] Short- Term Load Forecasting Using Artificial Neural Network Techniques by AnkitaShrivastava PG Scholar and ArtiBhandakkar Associate Professor, Department of Electrical & Electronics Engineering, SRIT, Jabalpur. ISSN: 2248-9622, Vol. 3, Issue 5, Sep-Oct 2013, pp.1524-1527.

[7] Short Term Load Forecasting Using Artificial Neural Network Technique by Ronak K Patel ,GTU PG Student, Ankit V Gajjar, Professor Department of Electrical Engineering, Kalol Institute of Technology and Research Centre Kalol, Gujarat, India. International Journal For Technological Research In Engineering Volume 1, Issue 9, May-2014.

[8] An Intelligent System For Forecasting Electric Load And Price by Sushmita Tiwari, Vaishalisingh and Rajiv Kumar, Department of Computer Science and Engineering Sharda University Greater Noida, India (IJCSIT) International Journal of Computer Science and Information Technologies, Vol. 6 (3) , 2015, 2121-2126.

[9] Short term electric load forecasting using Neuro-fuzzy modeling for nonlinear system identification by M. Mordjaoui, B. Boudjema, M. Bouabaz and R. Daira LRPCSI Laboratory, University of 20August, Skikda Civil Engineering Department, LMGHU Laboratory, University of 20August, Skikda, Algeria.

[10] A Methodology for Short Term Load Forecasting Using Fuzzy Logic and Similarity by E. Srinivas, Amit Jain, Member, IEEE, The National Conference on Advances in Computational Intelligence Applications in Power, Control, Signal Processing and Tele-communications (NCACI-2009), Bhubaneswar, India, March 20-22, 2009.

[11] Fuzzy Logic Approach for Short Term Electrical Load Forecasting by M. Rizwan, Dinesh Kumar and Rajesh Kumar Department of Electrical Engineering, Delhi Technological University, Delhi 110042, India, Electrical and Power Engineering Frontier Dec. 2012, Vol. 1 Iss. 1.

[12] Factor Affecting Short Term Load Forecasting by Muhammad Usman Fahad and NaeemArbab, Journal of Clean Energy Technologies, Vol. 2, No. 4, October 2014.