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FORECASTING OF LOAD AND ENERGY REQUIREMENTS

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Abstract : Load forecasting is an exercise of the power system to anticipate the future load demand. Accordingly generation capacity may be increased to cope up with future load demand. In this paper, it has been discussed that mere augmentation of generation capacity will not serve this purpose. Plant load factor of the power plants should also be increased as the same of old power plants are to be increased by renovation and modernization. This matter has been discussed by the analysis power perspective of the West Bengal upto 11th five year's plans, i.e.2012.

Keywords : Load forecasting, Load demand, Extrapolation.

1. Introduction

Since the beginning of electricity generation at the Edison De pearl street power station in U.S.A. electric power has shown tremendous growth and it has become a part of life and power now becomes the driving power of civilization. "Supply must follow demand" is also true in electrical industry, generations must be planned accordingly. At the time of Generation expansion it must be kept in mind that implementation takes time and needs a lot of capital investment. Decisions must be taken in advance for judicious and profitable investment in various projects to make them effective, useful and economical. For this purpose, the anticipated electrical power and energy demand should be known. Otherwise capacity addition may remain either excess or short to load demand. The resources available in the country for electrical power production e.g. for steam stations, hydro- stations, gas stations, etc. can then be utilized and exploited considering the electrical power and energy requirements and the locations and regions where the demand is expected. This anticipation of power and energy demand can be calculated by load forecasting.

Load forecasting is such an exercise that different models with different assumptions are likely to come up with different results, each with their set of assumptions and justification. The set of forecasts that come close to the actual can be treated as being the best one. One way is to look objectively at these forecasts by comparing them with reality. No particular forecasting method is however effective in all the situations. Because experience and good judgments of the planner can never be replaced. Again weather has such an influence on load requirements, that it is necessary to reflect weather conditions in forecasts. In general most utilities construct scatter diagrams correlating certain weather variables.

Correlation techniques of forecasting relate system loads to various demographic and economic factors also. This approach gives scope to the forecaster to understand clearly the inter-relationship between load growth patterns and other measurable factors. Typically such factors are population, employment, building permits, appliances saturation, business indicators and the like.

There have been various forecasts by states, by the Electric Power System etc., but a more realistic and transparent assessment based on quantitative analysis is missing. The entire concentration on load forecast has been on peak power and energy consumption giving little consideration to the load curve e.g. electric power survey also clearly presumes

that consumption pattern would remain as past and minimum load does not find any significant treatment.

Correct choosing of a forecasting technique is very important. Before choosing a particular method, whether it be simple curve fitting or stochastic modeling, a basic understanding of how a load behaves is essential. If, on the basis of data and good judgments, simple extrapolation appears to suffice, it should be used. Choosing the best technique for a given utility, once again requires a good judgments and knowledge of advantages and disadvantages of various available methods. Once a method has been chosen forecast must always re-evaluate its effectiveness because forecasting techniques can outline their usefulness.

2. Extrapolation

Extrapolation techniques involve fitting trend curves to basic historical data adjusted to reflect the growth trend itself. With trend curve the forecast is obtained by evaluating the trend curve function at the desired future point. Sometimes a very simple procedure produces reasonable results in some instances. Such a technique is to be classified as a deterministic extrapolation, since no attempt is made to account for random errors in the data or in the analytical model.

There are lots of equations and models which are used for this computation. Some of them are given below : -

Curve type Nature of the curve Equation

Linear-st-line- Y = $a + bx$

Quadratic- Parabolic - $Y = a + bx + cx^2$

N^{th} order polynomial s-curve- $Y = a+bx+cx^2+dx^3$

In practice most of the time target forecasted load may not be achieved due to different reasons and constraints. These constraints are Economical. Resource. Technological (lack of updated technology), Political, etc.

However forecasted load is not only very important but it is also essential because this will provide the planner the ultimate goal at least certain destination i.e. how far they are to go?

Now, one can explain and review this matter with an example. Let us consider the power perspective of West Bengal up to March, 2012 i.e. up to 11^{th} plan as the example.

Energy consumptions and peak demands of different organizations of power sectors of West Bengal are considered as basic data like D.P.L., C.E.S.C. and the then W.B.S.E.B and etc such curves are shown in Figure 1 (energy consumptions) and in Figure 2 (peak demand). Expected addition of generations of West Bengal is given in Table 1. Generated powers of central agency are distributed among the state of eastern and north eastern region. Five 5000MW of Balagarh Power Company limited and 600MW of Turga PSP, both these project have been postponed due to techno economic and socio political reasons.

It has been found in last two decades of last century that capacity is always greater than the maximum demand i.e. these plants are under utilized. Upto 93-94, 50% of the total capacity is hardly used. In next ten years this matter improves considerably.

This proves the utility of load forecasting. To meet up load demand, generation capacity should be increased but this correlation is not so simple and linear.

It must be noted here that augmentation of Generation capacity is not enough to meet up load demand. Some other factors are still necessary which should be given due infancies. Say Plant Load Factor (P.L.F.). In Figure 4. P.L.F. of some plants are shown. The fig4 shows some alarming picture. D.P.L. runs with only P.L.F. between 25% to 30%. Other power stations like Bandel, Santhaldihi also runs with poor P.L.F. In comparison with these, southern plant runs with high P.L.F. (88.14% at 97-98).So along with establishing new plants renovation and modernization programme should also be carried out essentially. Otherwise overall performance will not be good enough for running a sound power system.

Further, if one checks the peak demand and Energy requirement against availability, one sees that there is marginal difference between peak demand and availability from 1999 to 2007-2008, and then peak demand gradually becoming greater than availability up to 2012, i.e. at the end of 11^{th} five years plan. In respect of energy requirement against availability. It is found that availability is greater than demand from 1999 to 2007-2008. After then availability lacks to demands so result is comeback of chromic decrease of load shading during the said period.

In early seventies the state of West Bengal first experienced the acute problem of load shading. Since then this state has gone through cycles of acute shortage and occasional surplus in power availability and electricity demand has practically stagnated because of lack of industrial growth. Despite significant improvement in load shading index in Kolkata but other parts of the state including the district head quarters are still suffering from chronic problems of load shading. Figure 3a shows that the energy short-fall is very high in 91-92 and 93-94 and then loads gradually decreasing in 98-99 and energy consumption was also decreasing. This gradual decreasing is due to high growth of capacity addition which is shown in Figure 3b.

The present power scenario of west Bengal is shown in Table 2 and Figure 5.

Capacity addition also requires adequate transmission and distribution network. Along with capacity addition these two networks should also be augmented.

3. Transmission System

The existing transmission and distribution network of W.B.S.E.B. is not adequate to cater the load potential of West Bengal. To overcome this problem a massive transmission and distribution network development programmes have been undertaken by W.B.S.E.B. To cater the future load growth, C.E.S.C. has also undertaken construction of some transmission lines. The central Sector Transmission System will also be augmented to cater the future load growth.

4. Distribution System

In order to cope up with perspective power demand of West Bengal W.B.S.E.B. has formulated a need based distribution development programme for the period up to 2012 matching with Transmission Development Programme include establishment of new distribution system, augmentation of existing distribution system, modernization of rural distribution system, establishment of distribution automation system and establishment of intelligent metering system.

From an analysis of the growth variation over years as shown in Figure 3b, it transpires that there is a trend of alternately rising and diminishing growth rate of each of the power system i.e. generation, transmission and distribution. This can be attributed to non-homogeneous growth. Therefore with massive investment envisaged in transmission projects and also matching distribution schemes, moderate growth rates has been considered till the end of 11^{th} plan.

With the above trend of growth of demand and timely completion of the generation schemes in the pipeline it is observed that generally there was no shortfall in energy supply till 2007-2008. However, from the end of 2007-2008 particularly during summer energy shortfall in all probability has been occurred. Energy shortfall has become prominent from 2009-2010 and is likely to become critical in 2010-2011 and 2011-2012 with energy shortfall rising to more than 800MU a month.

Peak shortage of moderate amount has been continued till 2004-2005. There after Rammam Hydel Plant scheme pressed into service and as such peak shortage has been avoided almost till the end of 2007-2008. However, from 2008-2009 onwards peak shortage has again appeared and the position is likely to become critical from 2009-2010 and will ultimate in massive shortfall of 1250 MW by the end of 2011-2012.

With the energy shortfall soaring to more than 800 MU out of the requirement of more than 3600 MU a month and peak shortage reaching 1250MW out of a requirement of more than 6800 MW appropriate generation schemes have to be thought of right now for implementation.

With the energy shortage becoming prominent from 2008-2009 and gradually increasing reaching a figure as high as 820 MW a month as the end of 11^{th} plan, 2011-2012, it requires serious review of the implementation of the proposed Turga Project (Purulia pump storage – stage-II). But Purulia pumped storage stage-I which has already completed its synchronization must be given in the Grid essentially and immediately. Figure 3a shows that this state runs time to time with occasional surplus power. This surplus energy properly be utilized under an agreement with Gridco (Orissa) a hydel dominated system mutually beneficial to both. This may help in reduction of peak shortage to an extent utilizing the available hydro-thermal mix working as a virtual pumped storage among two systems.

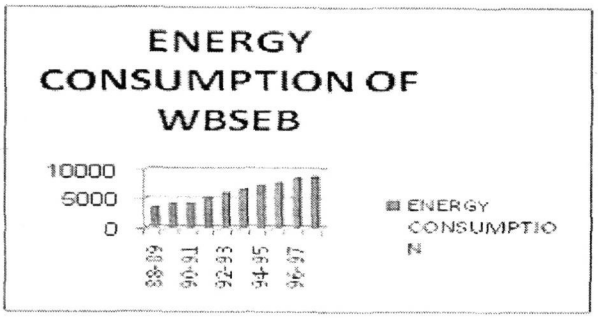


Figure 1
Modernized to have a good P.L.F. value

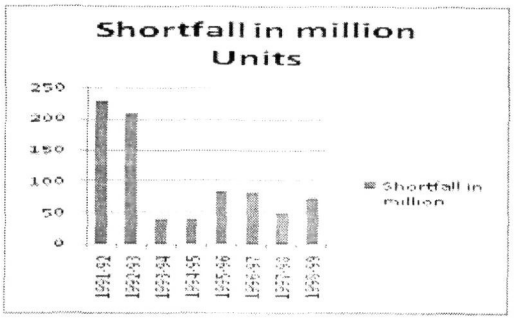


Figure 2

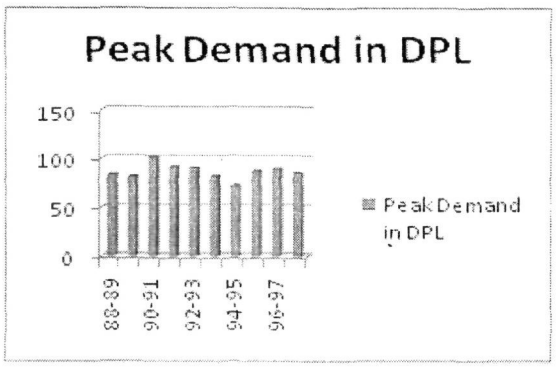


Figure 3a

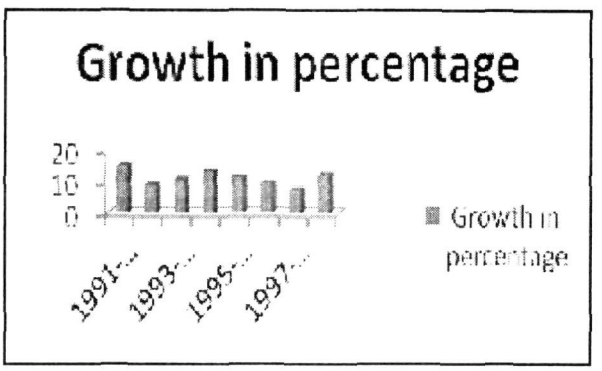


Figure 3b

Table 1 : Expected Addition of Generation of West Bengal and Central Sector

YEAR	AGENCY	PROJECT	UNIT	CAPACITY (MW)	Expected Date of Commissioning
1999-2000	CESC	Budge Budge	II	250	March 1999
	WBPDCL	Bakreswar	I	210	Nov. 1999
	NHPC	Rangit HPS	I	20	April 1999
			II	20	Oct. 1999
			III	20	March 2000
2000-2001	WBPDCL	Bakreswar	II	210	May 2000
			III	210	Sept. 2000
2001-2002	WBPDCL	Bakreswar	IV	210	April 2001
			V	210	Oct. 2001
2002-2003	Balagarh Power Co. Ltd. (subsidiary of CESC)	Balagarh	I	250	March 2003
2003-2004	-do-	Balagarh	II	250	Sept. 2003

(14) Forecasting of Load and Energy Requirements

Table 1 Contd/-

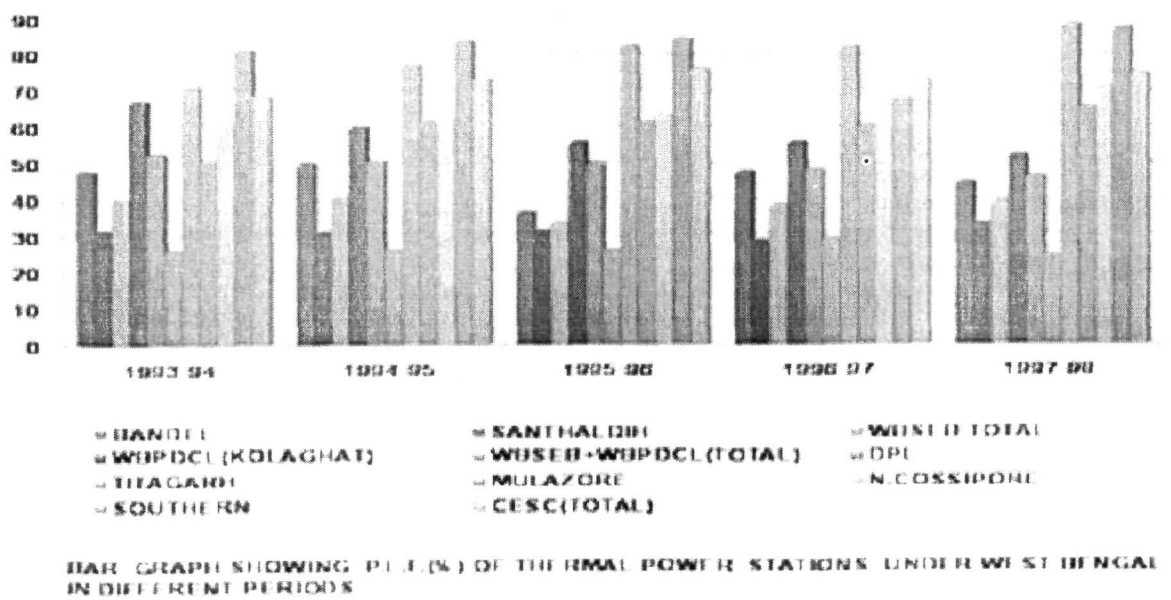
YEAR	AGENCY	PROJECT	UNIT	CAPACITY (MW)	Expected Date of Commissioning
2004-2005	WBSEB	PPSP	I	225	Sept. 2004
			II	225	Nov. 2004
			III	225	Jan. 2005
			IV	225	March 2005
	Royal Govt. of Bhutan	Tata HPS	I	170	April 2004
			II	170	Oct. 2004
			III	170	March 2005
2005-2006	-do-	-do-	IV	170	Sept. 2005
			V	170	March 2006
2006-2007	Royal Govt. of Bhutan	Tata HPS	VI	170	Sept. 2006
	NHPC	Teesta-V	I	170	Oct. 2006
			II	170	March 2007
	WBSEB	Ramman Stage-I		36	April 2006
2007-2008	NHPC	Teesta-V	III	170	Sept. 2007
		Koelkaro	I	172.5	April 2007
			II	172.5	Oct. 2007
			III	172.5	March 2008
2008-2009	NHPC	Koelkaro	IV	172.5	Sept. 2008
	WBSEB	Ramman Stage-III		60	April 2008
2009-2010	WBSEB	Turga PSP	I	150	April 2009
			II	150	Oct. 2009
			III	150	March 2010
2010-2011	WBSEB	Turga PSP	IV	150	Sept. 2010

Table 2 : Thermal Power Plants in West Bengal at Present

Power Station	Operator	Location	District	Region	Unit wise Capacity (MW)	Installed Capacity (MW)
Kolaghat	WBPDCL	Mechada	East Midnapore	Eastern	6 X210	1260
Bakreshwar	WBPDCL	Suri	Birbhum	Eastern	5x210	1050
Bandel	WBPDCL		Hoogly	Eastern	4x60 1x210	450
Santaldihi	WBPDCL		Purulia	Eastern	4x120 1x250	730

Table 2 Contd/-

Power Station	Operator	Location	District	Region	Unit wise Capacity (MW)	Installed Capacity (MW)
Sagar Digi	WBPDCL	Monigram	Murshidabad	Eastern	2x300	600
Durgapur	WBPDCL	Durgapur	Bardhaman	Eastern	2x30 1x70 2x75 1x110 1x300	690
Farakka Super thermal	NTPC	Nagarun	Murshidabad	Eastern	3x200 2x500	1600
Durgapur Thermal	DVC	Durgapur	Bardhaman	Eastern	1x140 1x210	350
Megia	DVC	Durlabpur	Bankura	Eastern	4x210 2x250	1340
Budge Budge	CESC	Achipur	24Pargnas (South)	Eastern	3x250	750
Titagarh	CESC	Titagarh	24Pargnas (North)	Eastern	4x60	240
Southern Generating	CESC	Kolkata	kokata	Eastern	2x67.5	135



BAR GRAPH SHOWING PLF (%) OF THERMAL POWER STATIONS UNDER WEST BENGAL IN DIFFERENT PERIODS

Figure 4

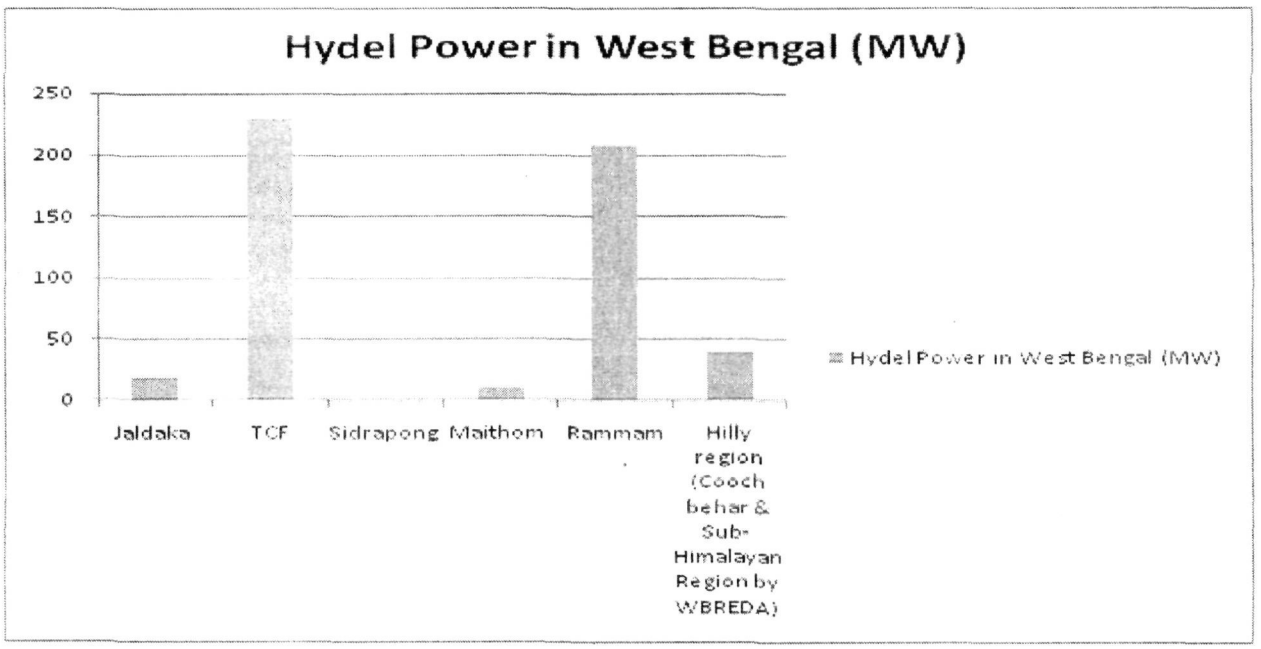


Figure 5

5. Conclusions

Load forecasting is very important as it provides the planners to set a target load for capacity addition i.e. how far they are to go? But due to some constraints this may not be achieved.

Besides forecasting and capacity addition some other areas are equally important where emphasis should be given such as plants should be run with good percentage of plant load factor. Old power plants either be closed down or must be renovated and modernized.

References

All data have been collected from West Bengal State Electricity, Bidyut Bhavan, Central Electrical Authority, Kolkata.

The great aim of education is not knowledge but action.
– Herbert Spencer