Study on Power System Planning in India

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ABSTRACT

This paper discuss the important aspects and issues related with power system planning in India. To Enhance the facilities of power system, one must to assess load forecasting. Future load growth in the face of uncertainties associated with future load forecasting, the type and availability of fuel for generating units, the complexity of interconnection between different agents and opportunities to exploit new technologies. In which manner we get suitable reliability that can assurance a continuous power flow with reasonable and acceptable cost. The proposed work will try to show the most tiring and main problems and issues that face electric power system in India and effects the decision making process.

Keywords: Planning, Reliability, Cost, Load, Interconnection

1. INTRODUCTION

Power system planning is a process in which the aim is to decide on new as well as upgrading existing system element to adequately satisfy the loads for a foreseen future. In India, power system planning has become more difficult, but more important to provide the necessary information to enable decision to be made today about many years in the future.

In this paper, we will consider power system planning where it is necessary to treat the system as a whole and choose the part in the system so that they give the required technical performance and are also economically justified. Under such a situation, the effort will be to make the system economical and not only one particular part of the system such as generation, transmission or distribution.

This framework should be flexible, not rigid with broad objectives of finding a plan which guarantees a desired degree of a continuous, reliable and least cost service. Good service or, in other words, acceptable reliability level of power system usually requires additions of more generating capacity to meet the expected increase in future electrical demands.

However, In India with vast, separately populated areas reliability–cost tradeoffs exist between satisfying the fast load growth by investment in additional generating capacity for isolated systems or building transmission networks to interconnect these systems and transfer power between their load centers in case of emergencies and power shortages. Therefore, reliability and cost constraints are major considerations in power system planning process.

2. GENERATION PLANNING

When the planning requirements have been determined, the next problem is to determine the type and size of generation station that will be required to supply power and energy. The selection of a site for the location of the generating stations depends on many factors including the cost of transmitting the energy to the consumers, of transporting fuel to the stations, the viability of sound foundations, the cost of land, the availability of cooling after and the avoidance of atmospheric pollution. Steam station should be located at the coal pits or as near the coal as possible to avoid transport cost and time of transport. For most economical distribution and the lowest cost of power and energy, the power station should be located at the center of gravity of load, if a suitable site is available. There is a trend for in the size of generator unit to be used in large power systems. This reduces the cost per kw and improves the efficiency of the station.

Careful choice should be made of the composition and characteristics of the generation plant and it should be possible to continue studies every time a new event occurs such as energy crisis which may affect the conclusions reached. The choice of sitting new thermal and unclear plants is studies as optimization problem using linear programing. The points considered are costs of production, transport and interaction with the environment to the minimum.

3. TRANSMISSION SYSTEM PLANNING

The major transmission requirements of a power system and their associated cost are much influenced by the location of future generation capacity. The object of transmission planning is to select the most desirable transmission network for each of the generation expansion patterns under consideration. Both economics and reliability are considered in the problem. The application of a digital computer in automated transmission planning allows the system planner to consider and investigate many alternatives quickly. The ultimate selection of generation expansion plan is ten done by considering transmission planning allows the system planner to consider and investigate many alternatives quickly. The ultimate selection of generation expansion plan is then done by considering transmission as an integral part of the total cost.

A basic problem in transmission line planning is the determination of transmission adequacy under the forced outage of various systems components. A more consistent approach to transmission planning would be to consider the reliability. The investment in transmission improvement is made t the desired location in the system, in terms of an acceptable risk level at the loading point.

The transmission system planned to satisfy the bus voltage and line loadings under normal operating condition may be adequate only if high risk level are acceptable. The cost of transmission improvements

Increase as higher reliability levels are expected. The use of quantitative reliability criterion facilities optimum utilization of the investments in transmission improvements.

4. DISTRIBUTION SYSTEM PLANNING

Since the system variable are quite complex, it is necessary to make a through analysis while planning distribution system. The problem to be studied in the total system environment for the purpose are (a) Selection of most economical combination of subtransmission and distribution voltage levels, (b) Determination of the economical sizes of substations, and (c) Combination of different methods of regulating voltage. Some of the important factors that should be considered are the actual geographical distribution of lads, configuration of the existing system, step by step expansion of the distribution system with time, and load growth and comparative reliability of the various arrangement.

5. RELIABILITY EVALUATION

The degree of performance of the elements of the bulk electric system that results in electricity being delivered to customers within accepted standards and in the amount desired. Reliability may be measured by the frequency, duration, and magnitude of adverse effects on the electric supply Reliability is one of the most important criteria which must be taken into consideration during all phases of power system planning, design and operation. Reliability is Ability of a system to perform its intended function. (a)Within a specified time period, (b) Under stated condition. Reliability criterion is required to establish target reliability levels and to consistently analyze and compare the future reliability levels with feasible alternative expansion plans. One capacity related reliability index, known as the loss of load expectation (LOLE) method. This method computes the expected number of days per year on which the available generating capacity is not sufficient to meet all the period load levels and can be evaluated as: (1)

where $p(O_k)$ is the probability of loss of load due to the k^t severe outage of size O_k; t_k is the time duration of that severe outage O_k will take; n is the total number of severe outages occurred during that period considered. Any outage of generating capacity exceeding the reserve will result in a curtailment of system power. Therefore, another power related reliability index, known as the expected power not served (ENS), is also used to complement the LOLE index, and can be defined as: (2)

Where $(ENS)_k$ is the energy not served due to severe k^{th} outage of size $O_{k.}$

6. RELIABILITY EVALUATION

In power system cost-benefit analysis, the outages cost (OC) forms a major part in the total system cost. These costs are associated with the power demanded but cannot be served by the system due to severe outages and is known as the expected power not served (e(ENS)). Outages cost will be borne by the utility and its customers. The utility outages cost includes loss of revenue, loss of goodwill, loss of future sales and increased maintenance and repair expenditure. However, the utility losses are small compared to the losses incurred by the customers when power interruptions occur. A residential consumer may suffer a great deal of anxiety and inconvenience if an outage occurs during a hot summer day or deprives him from domestic activities and causes food spoilage. For a commercial user, he will also suffer a great hardship and loss of being forced to close until power is restored. Also, an outage may cause a great damage to an industrial customer if it occurs and disrupts the production process. Therefore, for estimating the outages cost, OC, is to multiply the value of e(ENS) by an appropriate outage cost rate (OCR), as follows:

$$\mathrm{OC}_T = \sum_t \varepsilon(\mathrm{ENS}) \cdot \mathrm{OCR} \left(\frac{1+f}{1+i}\right)^t \tag{3}$$

The total cost of supplying the electric power to the consumers is the sum of system cost that will generally increase as consumers are provided with higher reliability and customer outages cost that will, however, decrease as the reliability increases. This total system cost (TSC) can be expressed in the following equation:

$$\mathrm{TSC}_T = \mathrm{SC}_T + \mathrm{OC}_T \tag{4}$$

The prominent aspect of outage cost estimation, as noticed in the above equation, is to assess the worth of power system reliability and to compare it with the cost of system reinforcement in order to establish the appropriate system reliability level that ensures both power continuity and the least cost of its production.

7. ISOLATED AND INTERCONNECTED POWER SYSTEMS

Interconnection of electrical power systems is an effective means of not only enhancing the overall system reliability but also reducing its operating reserve. The diversity existing between different systems in regard to their load requirements and capacity outages will allow the systems to assist each other in times of emergencies and generation deficiencies. The aim of this study is to specify the reliability levels for each system individually as a result of future load growth over the next eight years and the expected deterioration of reliability levels as a result of diminishing reserve and capacity deficit. After specifying the year that reliability level has exceeded the prescribed reliability level, capacity addition (new generating units) can be decided upon or interconnection with another system can be an optional solution. The interconnection reduces the amount of generating capacity required to be installed as compared with that which would be required without the interconnection. The amount of such reduction depends on the amount of assistance that a system can get, the transfer capability of the tie-line and the availability of excess capacity reserve in the assisting systems. Therefore, the study is focused on reliability evaluation of two systems both as isolated systems and as interconnected systems. Analysis of this type explores the benefits that may accrue from interconnecting systems rather being isolated as well as deciding viable generation expansion plans. The analysis represents the expansion plans for two systems as being isolated and interconnected. Higher reliability levels and lower installation and operation costs after the proposed interconnection between these selected isolated power systems take place.

8. OUTAGES COST EVALUATION

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9. LOAD FORECASTING AND ENERGY REQUIREMENT

Power system planning starts with a forecast of anticipated future load requirements. The term forecast refers to projected load requirements determined using a systematic process of defining future loads in sufficient quantitative detail to permit important system expansion decisions to be made. When planning to utilize the natural energy resources in India, it must be kept in mind that implementation takes time and needs a lot of capital investment. Decision must be taken in advance for judicious and profitable investment in various project to make them effective useful and economical. Forecast of demand for energy are required to estimate the additional installed capacity required to facilitate the plant maintenance programme and to estimate the plant capacity of restricted hydro plants.

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There are a number of upcoming issues that will affect the way electric system planning is done in New England. These issues include:

11. EMERGING ISSUES

- Integration of wind and other intermittent resources
- Growth in renewable resources driven by the states, renewable portfolio standards and potential federal actions that would promote use of renewables
- Accounting for the more aggressive energy efficiency growth policies
- Diversifying fuel resources
- Stricter environmental regulations
- Changes in regional and interregional cost allocation for new resources
- Additional merchant transmission projects
- Growth of smart grid technologies, and
- Governmental energy planning policies.

12. CONCLUSION

To successfully accelerate the development of Power system planning needs to be Lean and optimal. The results show the benefits and issue associated with both reliability and cost of interconnecting isolated systems into an integrated system. Therefore, their effects should be anticipated and detract their effects so that possible deterioration in system reliability levels as well as unnecessary additional expenditure can be avoid.

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