ORIGINAL RESEARCH PAPER

Engineering

Volume : 6 | Issue : 11 | November 2016 | ISSN - 2249-555X | IF : 3.919 | IC Value : 74.50

A Review of Transmission Expansion Planning Philosophy in India

KEYWORDS

Central Electricity Authority (CEA), Intra State Transmission System (Intra-STS), Inter State Transmission System (ISTS), Central Transmission Utility (CTU), Deregulated power system, Transmission Expansion Planning (TEP

Raminder Kaur

Assistant Professor, P.E.C University of Technology, Chandigarh

Tarlochan Kaur

Associate Professor and Head, Electrical Engineering Department, P.E.C University of Technology, Chandigarh

ABSTRACT *Indian power sector is one of the biggest and complex power system exists in the world hence typically need to be planned well in terms of its reliability, stability and mode of expansion at required stages. Several steps has already been implemented for the transmission corridors in India and several important steps need to be taken, As per govt. rules the Central Electricity Authority (CEA) has been appointed as the main planning authority in India for the transmission and overall power system planning in India. In this paper the main planning philosophy and its assessment is highlighted with all necessary constraints available.*

Introduction:

Transmission of electrical power with a complex network as in India is a big challenge hence, several optimization techniques and tools are being implemented with very high accuracy under simulation environment. Also several steps has already been implemented for the transmission corridors in India and several important steps need to be taken hence, as per demand of power the methods and ways of transmitted power need to be modified[1]-[3]. In Indian power system scenario, CEA takes care of all such decisions and requirements.

About CEA [4]-[5]

It is an agency of govt. of India which is responsible for overview transmission and generation planning. It manages the action related to the planning agencies given in section 73(a) of the electricity Act 2003 of Indian govt. The controlling of ISTS is governed by CTU. Similarly, on the other hand at state level, the efficient transmission system within that state is managed by the state transmission utilities which are liable for coordinating. Then there is an interconnection between the Intra-state and Inter-state Transmission utilities. These all collectively form the overall electricity Grid in India. Therefore, a uniform approach must be obtained for TEP to make a transmission system more reliable. The given planning criteria under CEA have a predetermined for planning of intra-state transmission system field to 66kV and inter-state transmission system 132kV of voltage level.

General Guidelines and the Planning Philosophy [5]

The electrical power supply has a crucial chain of transmission system that works as an interconnection between the generation and distribution or the load end of the electricity. In the Indian context, the two broad categories of transmission level covered, one is the intra-STS and ISTS. The top most layer of operation is ISTS which is operating at national level and the intra-STS that lies below it operating at state level.

Keeping in view, the requirement of the long term entities, such as, addition of generation capacity for overcoming increase in power demand, the transmission system is expanded.

Applicants requiring long term transmission facilities are mandatory to give their all requirements in advance, to the STU/CTUs so that the transmission capacity that is required can be made available, minimizing the stranded assets and connection required.

A long term cost effective and a perspective may be designed for the power corridor for extremely congested semi-urban/ urban areas.

The STU shall be the fundamental bureau for the state level, intra STS planning for coordinating with the alternators connected to the power network in a state and the distribution licenses as per the section 39 of the electricity act 2003.

Generally, the state level, the power is being provided by the state level power generation.

All the system loading component and also the system parameters shall be within the prescribed limit as given in the guidelines as described in coming sections.

Under the normal as well as under probable contingency conditions the system shall operate within the prescribed allowable limits. However, for rare contingency conditions the system cannot be planned.

The voltage limits options given below in table are based on transmission losses, reliability, right of wage, cost requirements etc. Table.1 below shows the voltage limits prescribed by CEA

Table. 1 [5]

VOLTAGE (kV) r.m.s				
Normal rating			Emergency rating	
Nominal	Maximum	Minimum	Maximum	Minimum
765	800	728	800	713
400	420	380	420	372

230	245	207	245	202
220	245	198	245	194
132	145	122	145	119
110	123	99	123	97
66	72.5	60	72.5	59

3.1 Reliability or consistency criteria [5]

3.1.1 Criteria for ('N-0') contingency

The thermal loading limits and voltage limits for equipments connected in a system shall be maintained.

There shall not be an angle which is more than 30° for the adjacent buses.

Criteria for ('N-1') contingency.

Steady –state criteria

In this type of contingency all the equipment connect to the system will operate within their permissible voltage and thermal ratings or limits after a certain perturbation without any load shedding or rescheduling of generator.

At most 30 degree phase separation is allowed in this type of contingency.

For inter-state Transmission planning

For the majority of the national level transmission system, transmission network shall be modeled at 220 kV voltage level, but for the part of Sikkim, Himachal, Uttarakhand and north-Eastern region the corresponding voltage level is 132kV.

The generation units are stepped up using step up power transformers at 132/110kV level that can be connected through a 220/132kV transmission system to the next 220kv available bus. The smaller units which are < 50MW capacity may be considered as a single unit, if the entire installed capacity which is < 220MW.

For Intra-STS system

The transmission system may be modeled at 66kV or at a level which is outside the authority of the distribution utility.

3.2 Time Horizons for Transmission System Planning.

For the actual commissioning of transmission line expansion the total time required is about 3 to 5 years. New transmission lines or substation requires about 5 years of time, while the expansion of any existing transmission system may require about 3 years of time.

For the load generation requirement usually base case models shall be prepared for a 5 year time horizon.

3.3 Planning margins

Due to a difference in load-generation requirement a lager power may flow within the system which is a challenging entity. It leads to overloading and congestion of transmission lines during a real operation. Prediction of their type cannot possible for the future. The overloading of the lines may also be possible because of an uncertain generation.

The transmission lines which are coming from a power generating station to the main grid may have a planning that taking into account the overload capacity of the power generating station.

A planning margin of 10% shall be given for the thermal loading of new addition of transmission lines and transformers. Also a 5% margin is given for inter-regional transmission lines.

A margin of 2% is assigned for voltage limits during planning.

TEP methods for a deregulated power system

The planning for transmission expansion deals with the difficulty of mounting an existing transmission system to serve load centers subject to a set of technical and economical constraints[6]-[9]. For any type of generation interconnected to the grid, the problem of inadequate export capability of the transmission system can occur.

4.1 Fundamentally there are two primary systems by which electrical energy can be transmitted.

(1) High voltage DC (HVDC) electrical transmission system.

(2) High voltage AC (HVAC) electrical transmission system.

To transfer power from generation plants to load centers efficiently, securely, economically and reliably a power transmission network is needed. A practical transmission network is always expanding and hence, for the construction of new lines the transmission expansion planning (TEP) should be well defined that considered all future span so that the increasing load demand can be met by shift of electrical power from existing and upcoming generation in a specified time span.

A transmission system gives the essential environment for competition among power market participants or power market player in deregulated power systems [10], Therefore as electricity demand move up TEP should be carried out in sensible time scale and also in a proper way to ease and promote competition among participants.

TEP is coordinated and centralized with generation expansion planning. Therefore, based on the certain reliability criteria [10] the power system planners can design the least expenditure transmission plan.

In case of large uncertainties in the system, TEP will not be coordinated with generation expansion planning. Hence, for load and dispatched power there may not be any fixed pattern in deregulated power systems or deregulated environment. In deregulated environments, due to uncertainties expansion of transmission networks have been faced with great problems. Therefore, the final plan must be carried out after the problem estimation for all available solutions. Since risk or problem estimation is typically based on probabilistic and stochastic methods, the methods based on probabilistic approach should be developed for transmission planning in deregulated power systems [11].

In conventional power system, the responsibility to serve the load demand of all existing and future consumers is carried out by a vertically integrated utility. For generation, transmission, distribution and consumer service businesses the utility is responsible, with the same goal of reliably meeting consumer energy demands at reasonable charge.

Volume : 6 | Issue : 11 | November 2016 | ISSN - 2249-555X | IF : 3.919 | IC Value : 74.50

The conventional approach to TEP is to decompose the problem into three main steps for keeping the optimization problem dutiful [12].

By using a basic model of the problem, create alternative candidate transmission expansion plans.

To direct the final expansion plan conduct a comprehensive financial and other analyses of these alternatives.

To guarantee the selected plan's viability carry out a technical impact analysis.

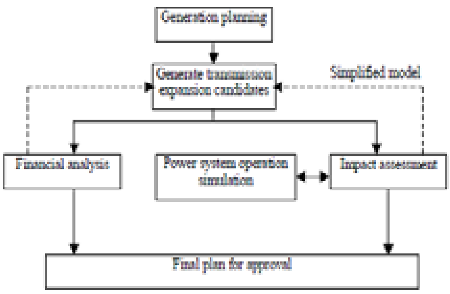

Fig.1.1 Traditional TEP procedure

Two interconnected categories can be classified to describe TEP in restructured environment which termed as transmission planning and transmission investment. There is an authority responsible for transmission planning in most of the jurisdictions, for example, independent system operator (ISO), who identifies most suitable or feasible expansion plans. These ISOs also carried out several responsibilities like system stability, power flow balancing and also ancillary services. There are also cases in which the investors propose and submit a plan to the transmission planning authority for its approval [13].

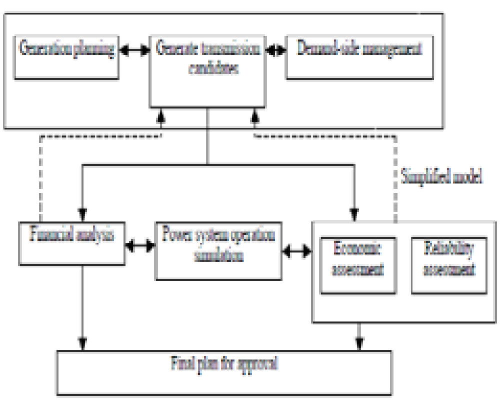

Fig. 1.2 TEP procedures in deregulated environment.

CONCLUSION

The entire power industry in India is undergoing a state of change, in some states of India there are several private utilities, which are financially and technically in a situation to enter the phase of a competitive electricity market. In conventional power system, the generation, transmission and distribution comes under a single authority but on the other hand, in deregulated of restructured power system all the above entities have their own operating facilities hence providing more options to opt for a better consumer requirement fulfillment. The deregulation came to India in late 90's since, started from Tamilnadu then it is growing rapidly. The TEP provided by CEA are designed for all possible future conditions and forecasting methods that are mainly based of probabilistic approaches. Hence, it is needed to supervise all possible solutions and problem finding technical aspects for a well managed and well designed TEP.

References:

[1] V. S. K. Murthy Balijepalli, and S. A. Khaparde, "Novel Approaches for Transmission System Expansion Planning Including Coordination Issues" ©2010 IEEE

[2] S. Masoud Moghaddas-Tafreshi, Vahid Asadzadeh, "Economics-Based Transmission Expansion Planning In Restructured Power Systems Using Decimal Codification Genetic Algorithm" IEEE Jordan Conference on Applied Electrical Engineering and Computing Technologies (AEECT),2011

[3] Mahendra Lalwani, Mool Singh "Conventional and Renewable Energy Scenario of India: Present and Future" ,Canadian Journal on Electrical and Electronics Engineering Vol. 1, No. 6, October 2010

[4] CEA General Guidelines for Substation, New Delhi, India, June 2012

[5] Manual on Transmission Planning Criteria, By CEA, New delhi, India January 2013

[6] Luminita BAROTE, Lonela NEGREA, "Wind Energy Probability estimation using Weibull Distribution Function " , Annals of the Oradea University. Fascicle of Management and Technological Engineering, Volume VII (XVII), 2008.

[7] T. Tachikawa, "A study of transmission planning under a deregulated environment in power system," in Proc. IEEE Int. Conf. Electric Utility Deregulation and Restructuring, pp. 649–654,2000.

[8] Len L. Garver, "Transmission Network Estimation Using Linear Programming", IEEE Transaction on Power Apparatus and Systems, Vol. Pas-89, No. 7, Sep./Oct. 1970.

[9] Natalia Alguacil, Alexis L. Motto, and Antonio J. Conejo, "Transmission Expansion Planning: A Mixed-Integer LP Approach IEEE Transactions on power systems, VOL. 18, NO. 3, AUGUST 2003

[10] Irenio de J. Silva, Marcos J. Rider, Ruben Romeroand Carlos A. F. Murari, "Transmission Network Expansion Planning Considering Uncertainty in Demand", IEEE Trans. on Power Systems, Vol. 21, No. 4, Nov. 2006.

[11] Pedro Sánchez-Martín, Andres Ramos, and Juan Francisco Alonso ,"Probabilistic Midterm Transmission Planning in a Liberalized Market", IEEE Transaction on Power Systems , Vol. 20, No. 4, November 2005.

[12] Amir Motamedi, Hamidreza Zareipourand W. D. Rosehart, "Transmission Planning in Deregulated Markets Considering Gen Cos' Strategic Behavior". http://iie.fing.edu.uy/investigacion/grupos/syspot.

[13] F. Gonzalez-Longatt and C. Fortoul, "Review of the Distributed Generation Concept: Attempt of Unification".