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TRANSMISSION MANAGEMENT IN DEREGULATED POWER SYSTEM IN PUNJAB STATE

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ABSTRACT*— In this paper a case study of restructured power system of Punjab is shown which is in the Northern Part of India has been carried out. The Electricity Act 2003, there has been tremendous improvement in power sector of this state. There is significant improvement in the areas of transmission and distribution, tariff rationalization and in availability of power supply. The Electricity supply is traditionally viewed as a natural monopoly. There is growing dissatisfaction with limited incentives for efficient operation of a cost-of-service regulated or government owned electric utility. As a consequence, regulators, worldwide, are now implementing new regulatory schemes and organizational reforms in an effort to improve the incentives for efficient operation of electricity utilities. All these reforms are consistent with the view that competition should be introduced into the electricity supply industry wherever it is technologically feasible. Recently Indian Electricity Act, 2003 was enacted to consolidate the laws relating to generation, transmission, distribution, trading and use of electricity and largely for taking measures conducive to development of electricity industry, promoting competition, protecting interest of consumers and supply of electricity to all areas rationalization of electricity tariff, ensuring transparent policies regarding subsidies, promotion of efficiency and environmentally benign policies. In this thesis various reformations made to the power system of Punjab state after restructuring are discussed. Transmission and Distribution losses, Commercial losses are discussed and the effect of restructuring is analyzed.*

Keywords—Electricity Act 2003, Restructuring, Punjab State Power Corporation Limited (PSPCL)

I. INTRODUCTION

The electricity sector in India is predominantly controlled by government sector entities via central public sector corporations, such as: National Hydroelectric Power Corporation, National Thermal Power Corporation and various state level corporations (state electricity boards - SEBs). The transmission and distribution is managed by the State Electricity Boards (SEBs) or private companies. The current per capita power consumption is about 734 kWh per year while the world average is 2,782 kWh. India is world's 5th largest energy consumer, accounting for 3.5% of global energy consumption. Due to India's economic rise, the demand for energy has grown at an average of 3.6% per annum over the past 30 years. More than 50% of India's commercial energy demand is met through the country's vast coal reserves. About 76% of the electricity consumed in India is generated by thermal power plants, 21% by hydroelectric power plants and 4% by nuclear power plants.

II. ELECTRICITY ACT 2003

The Electricity Bill 2003, approved in Indian Parliament in May 2003, aims to enhance the scope of power sector reforms. This act consolidates all the existing laws and introduces provisions with respect to new developments in the sector. It focuses on creating competition, protecting consumer interests, rationalizing tariff, etc. All the necessary powers including issue of licenses are given to the regulators which are made independent entities from the government.

Some of the silent features Electricity Act are:

1. Elimination of licensing for setting up a generating station, subject to compliance with technical standards. This excludes Hydro-Electric power station.
2. Removal of captive power plants from the ambit of licensing and other permissions Provision for issuing more than one license for transmission and distribution in the same geographical area.
3. Provision of 'Open Access' with respect to transmission for all generators (subject to technical constraints).
4. Introduction of a spot market for bulk electricity.
5. Unbundling of the SEBs on the basis of functions (Generation, Transmission and Distribution).
6. Compulsory metering of all consumers in order to improve accountability.

7. State Governments will have the freedom to decide the sequence and phases of restructuring, and also retain the integrated structure of the SEB for a limited period.

III. CASE STUDY OF RESTRUCTURING IN PUNJAB

The Punjab State Electricity Board (PSEB) was constituted as an integrated power utility under the Electricity (Supply) Act 1948. It continued discharging the generation, transmission and distribution functions until the reforms initiative were undertaken in the state. Like many other SEBs, the technical and financial performance of PSEB was not very much satisfactory in the pre-reforms period. Moreover, the provision of free power supply made available to farm sector further deteriorated the financial health of PSEB. Poor operational performance one of the major internal factors responsible for initiating power sector reforms. Another important reason was the role played by various international agencies such as World Bank started motivating various states to initiate power sector restructuring. Orissa was the first state which initiated the power sector restructuring in the distribution segment. Orissa State Electricity Board (OSEB) was unbundled into separate generation, transmission and distribution companies in 1996. Moreover, it also privatized the electricity distribution business in the state. Then, some other states such as Haryana, Andhra Pradesh etc., started power sector restructuring process. Most of the state's only unbundled the SEBs but did not privatize the distribution business. In the same process, the Government of Punjab also started taking steps in order to initiate the power reforms process at the state level. It constituted an Expert Group to suggest a suitable roadmap for power sector reforms process.

Generating Capacity of Punjab:

It has three types of Plant:-

1. Existing Thermal Plant

Sr.No	Plant	Total Generating Capacity	Total Generating Capacity
1	Guru Nanak Dev Thermal Plant Bhatinda	4 x 110 MW = 440 MW	2266 MUs
2	Guru Gobind Singh super thermal plant Ropar	6 x 210 MW = 1260 MW	6942 MUs
3	Guru Har Gobind Thermal Power Plant Lehra Mohabbat	920MW	220.8 Lac units daily

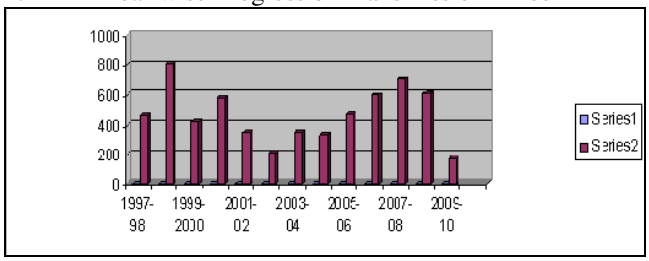
2. Existing Hydro Plant

Sr.No	Plant	Total Generating Capacity	Total energy contribution annually
1	Ranjit Sagar Dam Project, Shahpurkandi	600 Mw	2013.19 MUs
2	Shanan Power House, PSEB, Joginder Nagar	110 Mw	597.98 MUs
3	Anandpur Sahib Hydel Project	134 Mw	788.198 MUs
4	Mukerian Hydel Project, Stage-I	207 Mw	1069.73 MUs
5	U.B.D.C Power Houses, Stage-I & Ii	91.35 Mw	410.0 MUs

3. Micro Hydel Projects

Sr.No	Plant	Total Generating Capacity	Total energy contribution annually
1	Nidampur	800	0.08
2	Daudhar	1500	0.36
3	Rohti	800	-
4	Thuhi	800	-

4. Year wise Progress of Transmission Lines



IV. RESTRUCTURING OF PUNJAB STATE ELECTRICITY BOARD

The government of India has initiated reforms for liberalizing the power sector in the country to contain T&D losses, burgeoning subsidy burden and rampant corruption & for improving overall efficiency by making every individual accountable. The enactment of Indian Electricity Act 2003 was the first step in this direction. Joining the league of other states in India, regarding implementation of Power sector reforms, Punjab Government has also unbundled Punjab State Electricity Board (PSEB), which was a statutory body formed on 01/02/1959 responsible for Generation, Transmission and Distribution of electricity in the state of Punjab.

Govt. of Punjab carved out following two corporations out of erstwhile PSEB:

- Punjab State Power Corporation Limited (PSPCL)
- Punjab State Transmission Corporation Limited (PSTCL)

V. LITERATURE REVIEW

Vora Animesh, " Congestion Management in Degulated Power System- A Review", International Journal of Science and Research vol.3 Issue 6, June 2014, pp 2237-2240.

This paper presents a new method to mitigate congestion in a restructured Power system. In this paper, different cost-free methodologies were used to manage the congestion in the transmission network. To relieve congestion in transmission lines, there are two types of congestion management methodologies are discussed in this paper One is cost-free methods and another is non-cost free methods.

Elango.K, Panjothi.S.R, Sharmeela.C, "Congestion Management In Restructured Power System," International journal of applied enginnering reasearch, Dindigul Vol.2, No.2,2011.

In this paper author analyses the use of FACTS devices and Load Shedding for relieving congestion by Extended Quadratic Interior Point (EQIP) based OPF. The OPF problem is solved with the help of Evolutionary Programming (EP) approach and at major iteration, an approximation is made of the Hessian of the Lagrangian function using a Quasi Newton updating method so that the social welfare is maximized while satisfying the operation and security related constraints. The proposed algorithm has been analyzed on IEEE 57 bus system. The reactive power rescheduling and FACTS devices causes lower cost of rescheduling and the better voltage profile. The amount of reactive power supplied by the capacitor is less when it is compared to the capacitor reactive support. The proposed method gives the better results compared to the other methods.

Antonio J.Conejio, Fellow, IEEE, Raqual Garcia-Bertrand, Manuel Diaz-Salazar, "Generation Maintenance Scheduling in Restructured Power Systems," IEEE Transactions on Power Systems, Vol. 20, NO. 2, May 2005.
This paper proposes mathematical procedure to coordinate maintenance scheduling among the ISO and the appropriate degree of reliability is achieved throughout the week of the year in acceptable manner for every producer. This paper suggest the appropriate coordinating mechanism that allows to achieve generation maintenance plan that meet the expectation of maximum profit criteria. While achieving expectation level of reliability in every week of the year.

Uhlen, K, Warland, L, Grande, O.S, "Model for area price determination and congestion management in joint power markets," CIGRE/IEEE PES, 2005. International Symposium, vol., no., pp.100,109, 7-7 Oct. 2005.
The paper describes a simulation model where the flow based market coupling method is implemented and demonstrated. This method can be seen as a compromise between nodal pricing and market splitting (area pricing), where the criterion for congestion management is minimization of the socio-economic congestion cost.

S.Charles Raja, P.Venkatesh, Manasarani Mandala, "Comparative Study Of Two Congestion Management Methods for Restructured Power System," Journal Of Electrical Engineering & Technology Vol.6, No.3, pp 302-310,2011.

In this paper, cluster/zone method and relative electrical distance (RED) method for congestion management are compared based on the considered parameters. In the cluster/zone method, rescheduling of

generation is based on user impact on congestion through the use of transmission congestion distribution factors. Rescheduling cost, system cost, losses, and voltage stability parameter are also calculated and compared for the above two methods of congestion management. The results are illustrated on sample 6-bus, IEEE 30-bus, and Indian utility 69-bus systems.

Fang, R.S.David, A.K, "Transmission Congestion Management in an Electricity Market," IEEE Transactions On Power System, Vol. 14 No.3, pp 877-883, August1999.

This paper considers an open transmission dispatch environment in which pool and bilateral/multilateral dispatches coexist and proceeds to develop a congestion management strategy for this scenario.

L.A.Tuan, K.Bhattacharya and J.Daalder, "Transmission congestion management in bilateral markets: An interruptible load auction solution", Electric Power Systems Research, Vol.74, Issue 3, June 2005, pp. 379-389.

This paper presents an efficient method for solving congestion management problem with two conflicting objectives in a pool-based electricity market. In this paper, two efficient methods are proposed for solving congestion management problem in a day ahead electricity market by generator rescheduling. (1) transmission line over load and (2) congestion cost are optimized. This methods propose an efficient and reliable algorithm for line overload alleviation due to critical line outages in a deregulated power markets. The quality and usefulness of the algorithm is tested on IEEE 30 bus system.

K.Singh, Vinod K.Yadav, A.Dhingra, "Congestion Management Using Optimal Placement Of TCSC in Deregulated Power System", International Journal On Electrical Engineering and Informatics-Vol.4, No.4, December 2012.

This paper presents a congestion management methodology in deregulated power systems by making use of optimal placement of thyristor controlled series compensators (TCSCs) in transmission network. The paper is the modelling of TCSCs in power system. Development of usage cost of TCSCs, problem formulation and solution methodology of the proposed optimization problem. Discusses and compares results obtained after solving a 5-bus and IEEE 14-bus systems.

VI. CONCLUSION

As a result of restructuring Electricity Act 2003, the power scenario in Punjab in particular and all over India in general has improved significantly and hopefully will overcome the present grim power situation in future. From the case study of restructured power system of Punjab state, it is found that due to restructuring of the system their comes different benefits in terms of reduction in losses, efficiency improvement and reliability.

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