The Electricity Journal 29 (2016) 22–27

Contents lists available at ScienceDirect

The Electricity Journal

journal homepage: www.elsevier.com/locate/electr

# Power system restructuring models in the Indian context

Madan Mohan Tripathi[a,*], Anil Kumar Pandey[b], Dinesh Chandra[c]

[a] Delhi Technological University, New Delhi, India
[b] Uttar Pradesh Power Corporation Limited, Lucknow, India
[c] Motilal Nehru National Institute of Technology (MNNIT), Allahabad, India

ARTICLE INFO

Article history:
Available online 25 May 2016

*Keywords:*
Power system
Restructuring
Power pool
Retailer
Whole sale competition
Scheduling coordinator
Power exchange
Power purchase agreement

ABSTRACT

A range of new models is available for power system restructuring in India to meet the requirements of state and central government policies as well as the social and market needs of the state. Uttar Pradesh Power Corporation Limited provides a useful case study of these possibilities.



## 1. Introduction

The Electricity Act of 2003 ("the Act") came into effect on June 10, 2003, to replace earlier laws governing the Indian power sector, namely, the Indian Electricity Act 1910, the Electricity (Supply) Act of 1948 and the Electricity Regulatory Commissions Act of 1998.[1] The Act sought to create a liberal framework for the development of the power industry, promoting competition, protecting the interests of consumers and the supply of electricity to all areas, rationalization of the electricity tariff and ensuring transparent policies and the promotion of efficiency, among others. The Act came out with the National Electricity policy, mandatory creation of state electricity regulatory commissions (SERCs), emphasis on rural electrification, open access in transmission distribution, and some other provisions. It mandated that the regulatory commissions regulate tariffs and issues of license. It focused on laws relating to generation, transmission, distribution, trading and the uses of electricity. The objectives of the 2003 act are as follows:

- To consolidate the laws relating to generation, transmission, distribution, trading and the use of electricity.
- Promote competition.
- Protect the interest of consumers.
- Insure the supply of electricity to all areas.
- Rationalize electricity tariffs.
- Ensure transparent policies regarding subsidies.
- Promote efficient and environmentally benign policies.
- Guide the constitution of the Central Electricity Authority (CEA) and regulatory commissions.
- Establish an Appellate Tribunal.

The Act was amended on May 28, 2007, with stronger power and clarity and with greater emphasis on assessments, fines and the legal framework to check commercial losses due to theft and unauthorized use of electricity.[2]

With the enactment of the Electricity Act of 2003 and the implementation of open access, the market structure in the power sector changed from a single-buyer structure to a multi-buyer model. The generator could sell power to any buyer using the open access provision in transmission and users were given a choice of supplier: Since the Act was introduced, there has been increased competition among generators and suppliers, thereby improving the sector's performance. Currently many states, which have unbundled the state electricity boards (SEBs), have reported improvements in their operational efficiency and are able to ensure a reliable power supply to consumers.

Reforms in the power sector in India are underway to create more generation to foster greater competition among producers

* Corresponding author.
*E-mail address:* mmmtripathi@gmail.com (M.M. Tripathi).

[1] http://www.cea.nic.in/reports/electricity_act2003.pdf.

[2] http://www.mserc.gov.in/acts/no5_electricity_act_2007.pdf.

http://dx.doi.org/10.1016/j.tej.2016.05.002
1040-6190/

and greater choice for customers. The power sector in India was established as a vertically integrated/regulated monopoly organization and the generation, transmission and distribution facilities were owned and controlled by the central and state governments. (Both the central government and state governments were involved in generation and transmission, whereas distribution was handled by state governments only.) Different generating companies (independent power producers, or IPPs) and distribution companies (Discos) have been getting involved at the generation and distribution levels, respectively.

This restructuring has been accompanied by a variety of new problems, which have given rise to controversy among governmental organizations and private companies. The changing nature of the electricity utility industry has brought many new practices to power system operation.[3] The philosophy and techniques of planning and operation that had been well established over past decades have begun to change, and India needs to recognize and meet these challenges. To create competition in the power market, there may be different ways of restructuring the power industry. With a view to the organizational setup, financial condition, control structure and their coordination, several different types of reforms are being proposed in this article.

The rest of this article is organized as follows. Section II presents the various components of India's restructured power system. Various proposed restructuring models for the Uttar Pradesh Power Corporation Limited (UPPCL) are discussed in Section III. Section IV outlines the conclusions.

## 2. Components of restructured power system in India

The individual components of the restructured power system in India are discussed in detail below.

### 2.1. Central electricity regulatory commission

Under a new system of mixed entities comprising private and public firms, regulatory bodies at the central and state levels should provide a level playing field to all generating firms, reduce system costs, and protect consumer interests. In July 1998, a Central Electricity Regulatory Commission (CERC) was created to set tariffs and regulate interstate power exchange, licensing, planning, and other functions for all central generation and transmission utilities. The role of CERC in the states is largely advisory. It cannot overrule the state electricity regulatory commission (SERC). All appeals against a SERC decision can only be handled by the state's high court. We believe CERC should be empowered to fix the tariff for generation and transmission, enforce rules and regulations, and finalize the matter regarding interstate power exchange.[4]

### 2.2. Independent system operator

At the national level, an independent system operator (ISO) named the Power System Operation Corporation Ltd. (POSCO) – a wholly owned subsidiary of Power Grid Corporation of India Ltd (PLCIL)[5] – has been set up to serve as the supreme entity in control of the transmission system. We believe the ISO should be disassociated from all market participants, and abstain from any financial interest in the generation and distribution businesses. However, there is no such requirement, in the context of open access, to separate transmission ownership and operation. The ISO is not involved in energy markets and its role in generation (or transmission) scheduling will be limited to ensuring that submitted schedules are feasible. The ISO does not perform real-time control of power system facilities, which is performed instead by the regional load dispatch centre (RLDC), state load dispatch centre (SLDC) and area load dispatch centre (ALDC) that are hierarchically dependent on it. However, it monitors system operation to ensure the adequacy of available reserves and auxiliary services.[6] It coordinates measures to alleviate transmission congestion and performs contingency analysis to ensure system security against credible contingencies.

### 2.3. Transmission utilities

PGCIL started functioning as transmission unit (TU) in August 1991 with the mission of establishing and operating the regional and national power grids to facilitate the transfer of power within and across the region with reliability, security, and economy on sound commercial principles. As of Feb. 28, 2015, PGCIL owned and operated more than 1,13,841Ckt. kms network of transmission lines with 2,20,894 MVA transformation capacity and 189 nos. substations that constitutes most of India's interstate and inter-regional electric power transmission system and carries electric power across India. The total inter-regional power transfer capacity of PGCIL is 45,850 MW. PGCIL transmits mostly at 400 kV, together with 220 kV and some 132 kV AC transmission system crisscrossing the entire length and breadth of the country. HVDC back-to-back stations at Vindhyachal and Chandrapur and an HVDC bipole link (830 km) between Rihand and Dadri are also in operation. PGCIL is maintaining transmission system availability of over 99% and earned the unique distribution of being ranked among the best transmission utilities in the world. PGCIL also maintains 29,641 km of telecom network and it has a presence in 370 locations throughout the country with an intracity network of 68 cities across India.[7]

### 2.4. Central generation utilities

The National Thermal Power Corporation (NTPC), the National Hydro Power Corporation (NHPC), and the Nuclear Power Corporation (NPC) are central generating utilities which generate and supply power in bulk to the state utilities.[8]

### 2.5. Power pool controller

The power pool is controlled by a power pool controller (PPC) at the state level, with the price of electricity supplied through the pool determined every hour during peak hours and every three hours during other period, depending on system demand, bid prices, and the availability of generation and transmission. Wholesale sellers, retailers, or contestable customers buy electricity from the pool. The power pool thus provides a trading mechanism linking generators, wholesalers, and retail authorities and customers.[9] A separate unit can be created in the state's generation corporation to work as power pool controller. The PPC should have following responsibilities:

[3] http://www.cea.nic.in/reports/powersystems/nep2012/generation_12.pdf.
[4] http://www.cercind.gov.in/.
[5] http://posoco.in/.
[6] Khaparde, A S. A. Power sector reforms and restructuring in India, http://dspace.library.iitb.ac.in/jspui/bitstream/10054/260/3/30010.pdf.
[7] http://www.powergridindia.com/.
[8] http://powermin.nic.in/.
[9] Wadhera, Shym and Mazumdar, Robin, Evolution of regional power pools in India—current status and trends, Energy Conversion Engineering Conference, 1996. IECEC 96., Proceedings of the 31st Intersociety (Vol. 3), doi: 10.1109/IECEC.1996.553337.