ADVANCEMENT AND IMPLEMENTATION OF DEREGULATION IN POWER SECTOR: A CASE STUDY

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***Abstract*- In this paper, advancement of deregulation and restructuring in power sectors has been discussed. Need for deregulation in power sectors has been pointed out in this paper and hence implementation and benefits of deregulation in various country's power sector has been described. Implementation of deregulation in Indian power sector, the key issues related to power trading, which need to be addressed for structural development of electricity market in India, has been discussed. A model has also been proposed for the Indian Electricity Market.**

Keywords- Restructuring, Deregulation, ISO, TOA, Pool, IPP.

I. INTRODUCTION

In the modern era, demand of electricity is increasing day by day. From basic to luxurious needs, electricity has become an essential part of life. We are heavily dependent on electricity for our industrial and economic growth. Due to increase of power demand and supply, it is a difficult task to manage the generation and cost, simultaneously for one single organization. To reduce monopoly of one organization and to provide quality and reliable power supply at reasonable cost, it is necessary to encourage competition in power market. This can be possible by introducing restructuring and deregulation in power sector [1].

From the starting of electrical power industry, it was handled by single organization (private or government), that generated, transmitted and distributed electric power and services. The concept of deregulation came in early 1990s, which brought changes in electricity market to encourage competition. Restructuring is an important aspect of deregulation. It involves the unbundling of regulated power system into vertical and horizontal components. Vertical components constitute GENCOs, which are responsible for generation, TRANSCOs, which handle transmission and DISCOs, which are responsible for distribution. Horizontal components consists of different generation and distribution companies [2].

Deregulation is changing the rules of power trading such that it encourages competition in electricity market to provide reliable and good quality power supply at minimum cost [3]. The introduction of deregulation in power sector has facilitated privatization, due to which customers are getting choices of different power suppliers, which in turn results reliable and good quality power at reasonable cost. Due to these benefits of deregulation many countries have already adopted the concept of deregulation and the remaining countries are striving towards it.

Deregulation was first employed in Chile, after that it was followed by England, USA, Norway, Sweden etc. [4]. In India some states have already applied restructuring to their power sector but deregulation is yet to be fully implemented Restructuring has been encouraged by the benefits of deregulation in telecommunication and airline industries resulting in competition leading to economy and better customer service.

II. TERMS IN DEREGULATION

Some important terms which are frequently used in deregulation are as follows:

- **IPP:** These are independent power producers who can be an individual or an organization, which produces electricity for its own use or can sell power to open market, whenever available through TOA.
- **TOA:** Transmission Open Access, which provides open access of transmission grid to any power producer. Anyone or any organization which generates electricity can fed its power into transmission grid for selling. Thus TOA has encouraged different GENCOs and IPPs to involve in the electricity market.
- **Wheeling:** It is the transfer of power from one point to another point by using the facilities of transmission or distribution agencies on payment of charges.
- **ISO:** Independent System Operator, which governs the transfer of power and fix charges for it. The main requirement of ISO is that it should not be involved in generation or distribution by any means.

- **POOL:** It is a forum which matches demand and supply based on bid prices. Bidding is done one day ahead for a time frame of one or half an hour of the day.
- **POWER EXCHANGER (PX):** It operates the pool and provide bidding for both generation companies and retailers. Bidding is done in such a way that it maximizes profit.

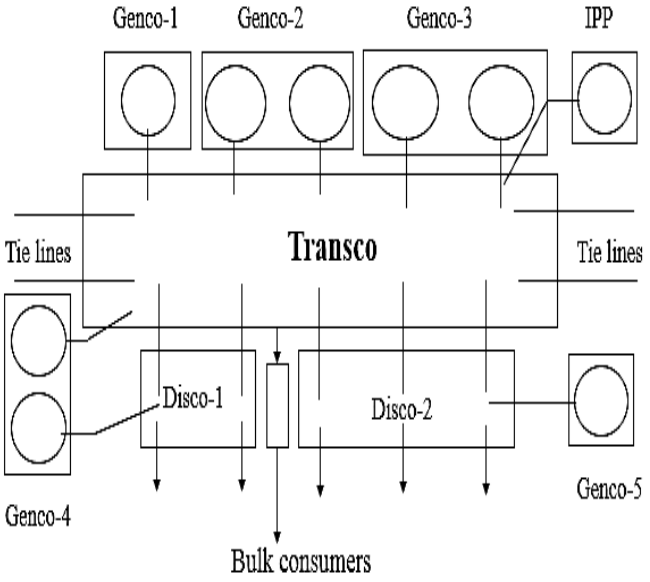

Fig. 1 Deregulated power systems

Fig. 1 shows the various components of deregulated power system.

III. IMPLEMENTATION OF DEREGULATION

As already stated, various countries have applied deregulation in power sector. Implementation of deregulation in some countries are explained below.

A. ENGLAND AND WALES:

Before deregulation, CEGB (Central Electricity Generating Board) was handling generation and transmission and distribution was handled by 12 RECs (Regional Electricity Companies). Deregulation was initialized by British Electricity Act, 1989, which divided CEGB into four parts, viz. generation, transmission, distribution and supply.

Now, transmission is handled by National Grid Company which is privately owned and distribution is handled by 12 RECs which has regional monopoly. England and Wales power market is second in European Union. It follows the pool model which is shown in fig. 2. All generators can sell their power only via pool which uses single auction model for bidding which is shown in fig. 3. England and Wales pool model bids for half an hour time frame and also setting which generator will fulfill forecast demand. Electricity trading arrangement review published in July 1998 has abolished the pool model. Now NETA (New Electricity Trading Arrangement) which is similar to Scandinavian model is used for electricity market

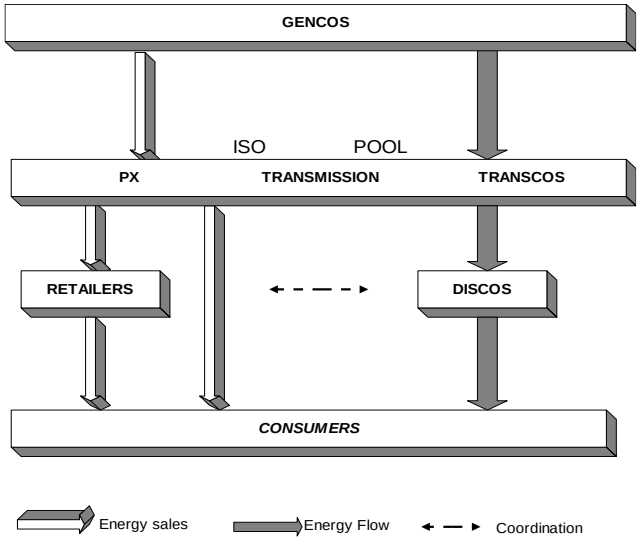

Fig. 2 Power Pool Model

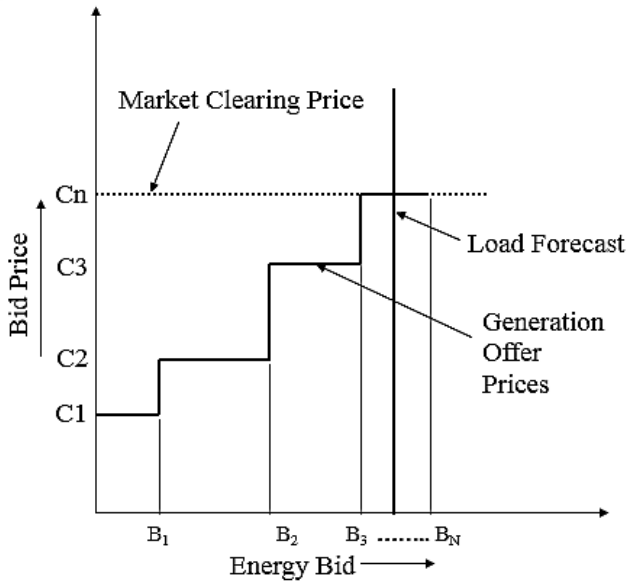

Fig. 3 Single Auction Bidding Model

In NETA, discriminatory auction replaced uniform auction. Demand side bidding is also allowed which transformed single auction model into bilateral auction model shown in fig. 4. NGC balances production and demand on a balanced second by second basis. In this process NGC buys and sells 2% of electricity demand. Privatization has decreased the generation cost but the cost reduction has been retained by generation

companies in terms of higher profit and it has not been fully passed to retailers yet.

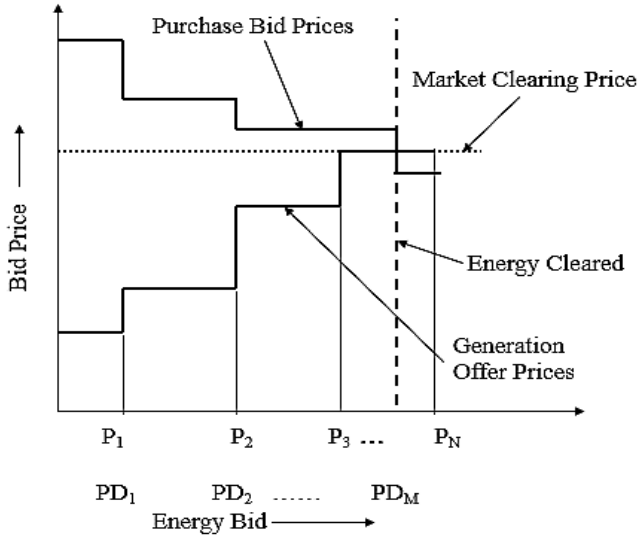

Fig. 4 Bilateral Auction Bidding Model

B. CHINA:

China is the second largest country in electricity consumption. It started the change in regulation and restructuring of power sector in 1997. In 1998 ministry of power was dissolved and further in 2002, SERC (State Electricity Regulatory Commission) was formed. In 2004 transmission assets were separated from generation and East China started pilot regional power market operation.

Goals of designing the SERC were as follows:

- to improve efficiency and reduce costs
- to lower electricity prices
- for economic development of Western China
- for environmental improvement.

To achieve these goals SERC performs the following functions:

- it develop the rules and regulations
- monitor electricity operations
- design tariff structures and adjustments to governmental pricing authority
- investigate any possible violations of laws and regulations
- maintains the market efficiency.

In China transmission is handled by two transmission grid companies, State Grid Company and South China Grid Company and generation is mainly handled by five generation companies, as shown in fig. 5. China has mainly corporate generation in a single buyer market. The generation companies which are separated from monopoly integrated vertical power system but still under the state ownership are called corporate (state) companies and forming corporate generation is called Corporatization.

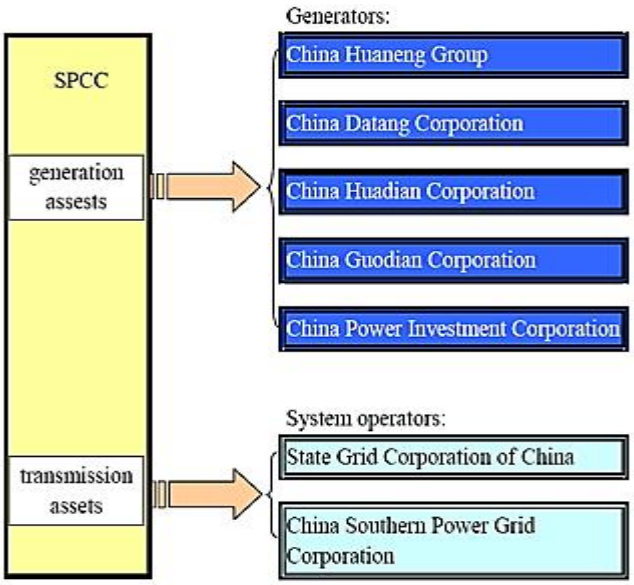

Fig. 5 Restructuring of China Power Structure

Single Buyer model is a liberalization model proposed by France in 1994. In this model, power is purchased from power producers and sold directly to users or via monopolistic retailers.

However, generation is still mainly based on coal-thermal plants, so to fully optimize the generation and deregulation there is a need to develop other generations.

C. UNITED STATES OF AMERICA:

USA is the largest country in electricity consumption. First baby step towards deregulation was taken by PUHCA (Public Utility Holding Company Act), 1935, in which large companies were given monopoly to their region but prevented to further expand their reach. Holding companies were forced to break up and sell reliable electric power to customer at regulated rate. The main step towards deregulation was taken in 1978 by PURPA (Public Utility Regulatory Policies Act), which forced utilities to use renewable energy. Further in 1992, National Energy Policy Act allowed different producers to sell their electricity to utilities. In 1996, FERC (Federal Energy Regulatory Commission) facilitated Transmission Open Access. Thereafter New Hampshire Launched a pilot program allowing competition which fueled the fire for a national deregulation plan. In 1998, California started selling their generating capacity to Independent Power Producers.

Deregulation is mainly handled by three groups:

- American Public Power Association represents utilities owned by municipalities or other govt. agencies and they favor government monitoring of electric market to ensure fair pricing and access.
- Edison Electric Institute, the giant trade association of investor owned electric companies and utility holding companies, which are free of government oversight that would favor rural, independent and government owned utilities.
- National Rural Electric Cooperative Association which represents consumers owned cooperative electric utilities. It wants Congress to give regulatory authority to states and allow electricity cooperatives to regulate themselves.

USA is divided into ten NERC (North American Reliability Council) reliability regions, which are WECC (Western Electricity Coordinating Council), MRO (Midwest Reliability Organization), SPP (Southwest Power Pool), SERC (Southeast Reliability Corporation), RFC (Reliability First Corporation), NPCC (Northeast Power Coordinating Council), FRCC (Florida Reliability Coordinating Council) TRE (Texas Regional Entity), ASCC (Alaska System Coordinating Council), HICC (Hawaiian Islands Coordinating Council).

The California follows pool and bilateral model for their power market as shown in fig. 6, whereas New York follows the multilateral market structure which can be represented as the model shown in fig. 7. In this model there is no pool and power exchanger, which are used in pool and bilateral model.

USA uses bilateral auction model for their bidding system.

USA has set up a milestone in deregulation from very early days. It has introduced the concept of smart grid technology which has also enhanced the reliability of power and has reduced the cost of power. It has also enabled the small power producers to come into the electricity market with the advancement in renewable energy sources.

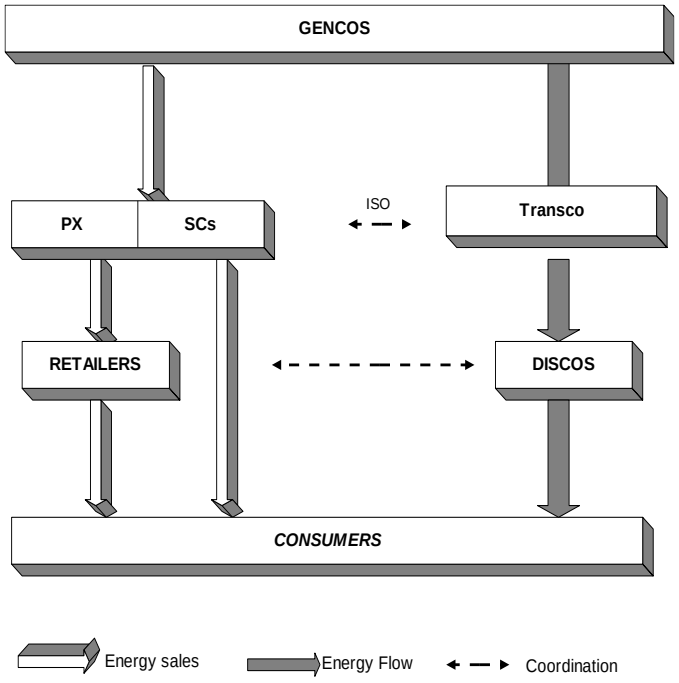

Fig. 6 Pool and Bilateral Model

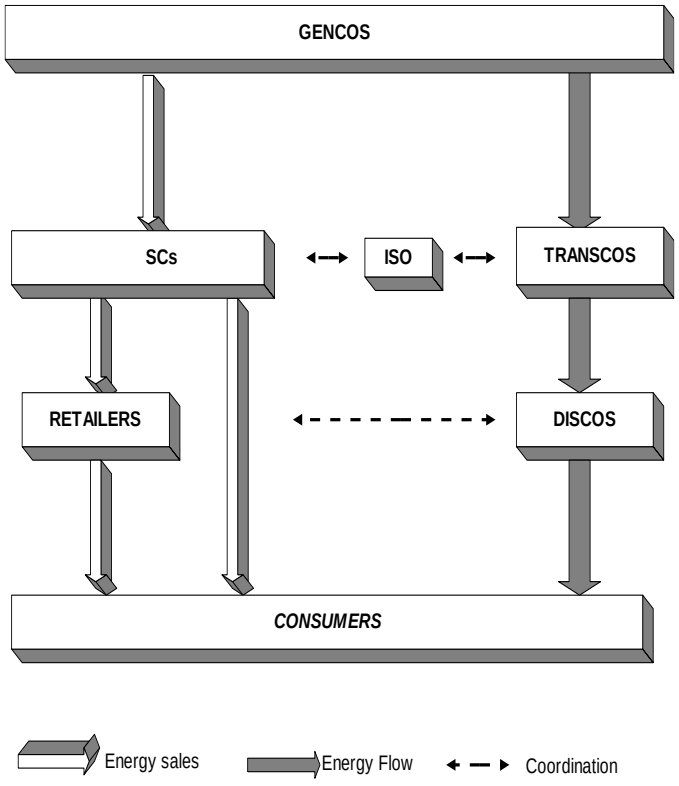

Fig. 7 Multilateral Trade Model

D. INDIA:

India is the largest consumer of electricity among the developing countries. Success of deregulation in telecom sector has fueled the process of deregulation in electricity market. Before independence generation was totally handled by private companies. After the enactment of New Electricity Act in 1948, generation was mainly done by state owned companies and managed by vertically integrated SEBs (State Electricity Boards). In 1975, government of India entered into generation. Transmission was separated in 1998 by the Electricity Regulatory Commission Act, to invite greater participation in investment from both private and public sector.

Steps towards deregulation was taken by the Electricity Act 2003. The steps taken for reformation of power sector were as follows:

- Unbundling of SEBs.
- Setting up of Regulatory Mechanism.
- Private Sector Participation in Transmission.
- Privatization of Distribution.

Restructuring has been done in various states starting with Odisha in 1996, followed by Haryana (1999), Andhra Pradesh (1999), Karnataka (1999), Uttar Pradesh (2000), Uttarakhand (2001), Rajasthan (2001), Delhi(2002), Madhya Pradesh (2002), Assam (2004), Gujarat (2004), Maharashtra (2005), West Bengal (2007) and Bihar (2011).

Currently, SLDCs (State Load Dispatch Centers) are carrying out the optimum scheduling of the state generating units and the RLDCs (Regional Load Dispatch Centers) are responsible for scheduling of central sector generating units only. SLDCs send the requisition to the RLDCs against their entitlements out of available power from CGS (Central Sector Generation) and the RLDCs allocate total available power to various states in the ratio of their entitlements. Day-to-day operation of the regional grid is carried out by RLDCs, which are under the operational control of CTU (Central Transmission Utility), i.e. Power Grid Corporation of India Ltd. all amount of power (about 2.5% of total generation).

Apart from above, a small amount of generation is being traded at wholesale level through either bilaterally or with the help of power traders. But presently, trading is mostly restricted to players such as SEBs and utilities. Current market structure of Indian power sector is shown in fig. 8.

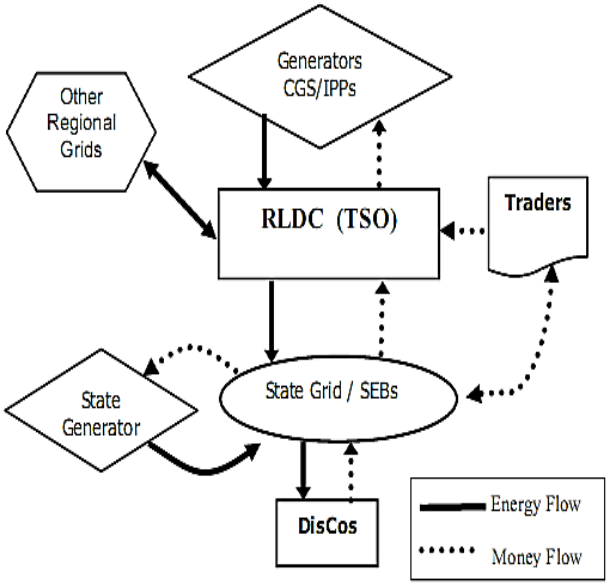

Fig. 8 Current Electricity Market Structure in India

However, power trading has barely got off the ground in India, there are some major issues related to power trading, which need to be addressed for structural development of electricity market in India. These key issues include:

- non-existence of power traders, they are just matchmakers.
- lack of pricing mechanism.
- unsurety of reliability of supply and off-take
- lack of information.
- lack of proper risk management.

Fig. 9 illustrates a simplified, theoretical model of the proposed national power market having different interactions between the relevant actors that participate in electricity market.

All the market participants will electronically submit their bids and offers to the PX and PX will clear the market by determining MCP (Market Clearing Price) from intersection of aggregated supply and demand curves. The PX will get the ATC information from NLDC (National Load Dispatch Center) on DA (Day Ahead) basis for congestion management and prepares the final DA schedule for the transactions to be cleared. Then PX submits this schedule to NLDC for real-time implementation. Next day 00h00 to 24h00 power will be delivered and financial clearing can done once a week.

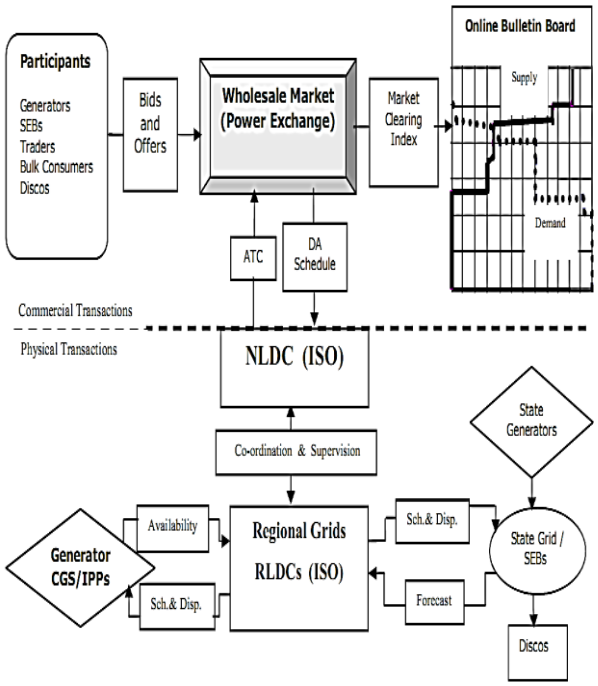

Fig. 9 Proposed Electricity Market Structure for India

In decentralized trading arrangement, PX has to be a separate entity from system operator, as an independent market operator. But PX should have strong co-ordination with system operators (NLDC/RLDCs) for ATC (Available Transfer Capability) information, dispatch of DA schedules and imbalance settlement through UI (Unscheduled Interchange) mechanism.

IV. CONCLUSION

Developed countries has already fully deregulated their electricity market. Seeing the benefits of deregulation, other countries are also implementing it. As demand and hence supply is increasing day by day deregulation is the need of the hour. But still there are some issues which needs to be solved to fully utilize the fruits of deregulation. In India steps has been taken for deregulation but it is not yet fully implemented. Researches are being extensively carried out in this area and in near future whole world may go towards deregulation.

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