Available online at http://www.journalcra.com

International Journal of Current Research
Vol. 10, Issue, 06, pp.70474-70478, June, 2018

INTERNATIONAL JOURNAL OF CURRENT RESEARCH

ISSN: 0975-833X

RESEARCH ARTICLE

RESTRUCTURING AND DEREGULATION OF POWER SYSTEM -A REVIEW

[1,*]Pawan C. Tapre, [2]Dr. Dharmendra kumar Singh and [3]Dr. Sudhir Paraskar

[1]Scholar, Bilaspur Department of Electrical Engineering, CVRU, Ph.D. (C.G.), India
[2]Associate Professor, Department of Electronics Engineering, CVRU, Bilaspur (C.G.), India
[3]Professor, Department of Electrical Engineering, SSGMCE, Shegaon(M.S.), India

ARTICLE INFO

Article History:
Received 18th March, 2018
Received in revised form
23rd April, 2018
Accepted 29th May, 2018
Published online 30th June, 2018

Key words:
Regulation, Restructuting,
Deregulation,
Electricity Market.

ABSTRACT

In several decades, the electric power industry has been structured as vertically integrated utilities which can generate, transmit and distribute power to the consumers. These utilities operate according to the policies, guidelines and regulations framed by the government and are responsible for the development, expansion and standardization of electric power industry. These state-owned utilities are obliged to provide electricity to every customer in a region and are assured of fair returns without any risk. This assurance has led to incompetent and lethargic attitude in the industry with lack of motivation for technical innovation, good management and customer focus. Hence most of the utilities are undergoing restructuring to overcome the adversities of monopolistic market. Restructuring of power industry aims at abolishing the monopoly in generation and trading sectors, thereby introducing competition at various levels, wherever possible. Competitive generation provides a market within which independent firms compete on the basis of price, to sell electricity directly to the large consumers and to supply electricity, via common carrier transmission, to distributors who in turn sell power to final users. Thus the electricity in restructured power market, is dispatched with the help of either power exchange or the pool/system operator. Power sector restructuring, popularly known as deregulation, is expected to attract private investment, increase efficiency, promote technical growth and provide good customer service with improved system efficiency.

Citation: Pawan C. Tapre, Dr. Dharmendra kumar Singh and Dr. Sudhir Paraskar, 2018. "Restructuring and Deregulation of Power System -A Review", *International Journal of Current Research*, 10, (06), 70474-70478.

INTRODUCTION

Brief history of electric power

- Early 1880's – Edison introduced Pearl Street dc system in Manhattan supplying 59 customers
- 1884 –DC motor
- 1885 –Transformer
- Late 1880's – Tesla invented ac induction motor
- 1893 – First 3 phase transmission line started operating at 2.3 kV
- Early 1900's – Private utilities supply all customers in area (city); recognized as a natural monopoly; states step in to begin regulation
- By 1920's – Large interstate holding companies control most electricity systems
- 1930's – Electric utilities established as vertical monopolies

****Corresponding author:*** **Pawan C. Tapre**
Scholar, Bilaspur Department of Electrical Engineering, CVRU, Ph.D. (C.G.), India
DOI: https://doi.org/10.24941/ijcr.30516.06.2018

Vertical monopolies

- Within a particular geographic market, the electric utility had an exclusive franchise.
- Within its service territory each utility was the only game in town.
- Neighboring utilities functioned more as colleagues than competitors.
- Utilities gradually interconnected their systems.
- By 1970 transmission lines crisscrossed North America, with voltages up to 765 kV.
- Economies of scale keep resulted in decreasing rates, so most every one was happy.
- Started in 1970 -
- 1970's brought inflation, increased fossil-fuel prices, calls for conservation and growing environmental concerns
- Rates started increasing
- After 1970's….
- Continuously increased rates of electricity

- As a result, U.S. Congress passed Public Utilities Regulator Policies Act (PURPA) in 1978
- It was mandatory for utilities to purchase power from independent generators located in their service territory
- PURPA introduced some competition
- Major opening of industry to competition occurred as a result of National Energy Policy Act of 1992
- This act mandated that utilities provide "nondiscriminatory" access to the high voltage transmission
- Goal was to set up true competition in generation
- Result over the last few years has been a dramatic restructuring of electric utility industry.
- Energy Bill 2005 repealed old act (modified PURPA)

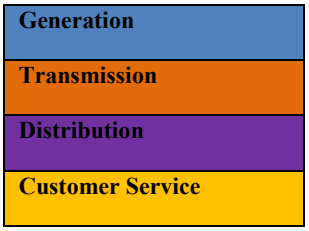

Fig 1. Vertical Monopoly

Milestones of deregulation

1982-Chile	1994-Australia
1990-UK	1996-New Zeeland
1992-Argentina, Sweden, Norway	1997-Panama, EI Salvador etc
1993-Bolivia, Colombia	1998-California, USA etc

Table 1. Comparison of old & new set up of power system

Old setup of power system	New setup of power system
Vertical operation.	Removal of monopoly.
Generating units happened to be away from the load centers.	Introducing Deregulation.
Difficulty to meet the demand from consumers with the existing generation.	Increased reliability.
Higher cost of electricity.	Reduced prices of electricity.
No Option to power consumer to buy electricity.	More options to power consumers to buy electricity.

Power Industry Development

Regulation

- Earlier setup being run with regulation.
- Laws and rules set up to carry out the generation, transmission and distribution functions
- Generation, transmission and distribution remain as one company.
- Under regulation , Government can
- Control Electrical Power Industry
- Own and operate it as its utility.

Important Characteristics of Regulation

- Operates under monopoly franchis
- Obligation to serve
- Regulatory operation confirming to guidelines and rules set up by Government regulators
- Least cost operation-minimum revenue requirement
- Assumed rate of return
- Difficult to separate the cost on generation, transmission and distribution

Structure of Regulated Power Industry

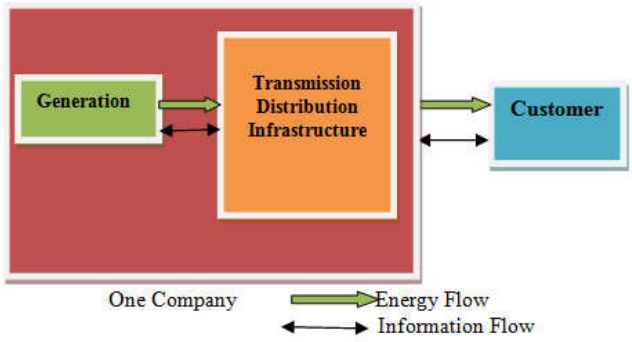

Fig 2 Structure of Regulated ← - - - - - Money Flow

Some Facts for sliding towards Deregulation

- Highly Increased use of electricity
- Electricity could be thought of as an essential commodity
- Motivation from private industries of doing better job of running power industry
- Increased competition brings innovations, efficiency and lower costs
- Overstaffing in the regulated electric industry
- Lack of public resources for development
- Increased deficit in budget & Lack of willingness of policymakers
- New concept of Power Industry with restructuring of laws and rules
- Deregulation can make it possible to divide the power system into different sectors –
  - Generation
  - Transmission
  - Distribution

Major reforms in power industry due to deregulation

- Separation of transmission & distribution activities from the generation
- Increased number of generation companies which could transmit the power over the same network
- Consumers to get better options for utilizing the power such as the power at-
  - better quality
  - reliability
  - economy
- Reduced prices of electricity up to 50 %
- Reduced service losses
- Removal of monopoly of local electric utility
- Improved reliability of the entire system
- Increased competition amongst the power producers
- Separation of electricity bill into different components

Different entities in the deregulated environment

- **GENCO-** Generating company which sells power at its outlet.
- **TRANSCO-**Transmission company that moves power in bulk from GENCOS to where it is delivered.
- **DISCO-**Distribution company, delivers power to end consumers.

- RESCO-Retail Energy Service company which purchasespower from spot market or directly from the GENCOS and sells it to consumers
- ISO-Independent System Operator, an independent authority responsible for entire operation and control of the entire system
- CUSTOMERS-End point of the eregulated power industry

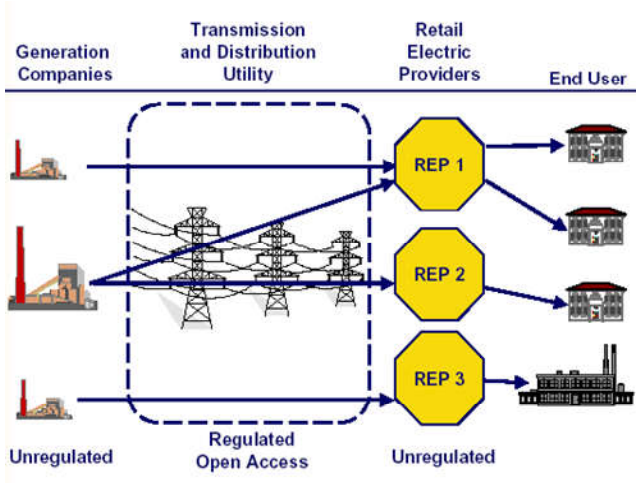

Fig. 3. Major reforms in power industry due to deregulation

Structure of Deregulated Power Industry with various entities and flows

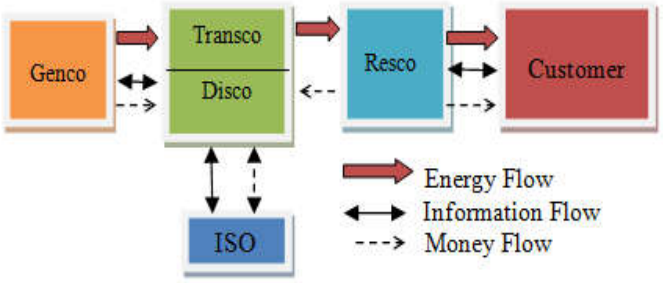

Fig. 4. Structure of Deregulated Power Industry with various entities and flows

From Regulation to Deregulation

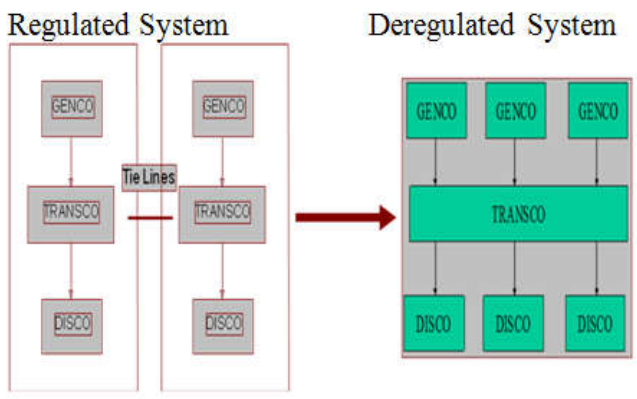

Fig. 5. Regulation or Restructuring denoted breaking up of the Vertically Integrated Utility (VIU) structure into Competitive Market Entities

Deregulation –Competition and Monopoly

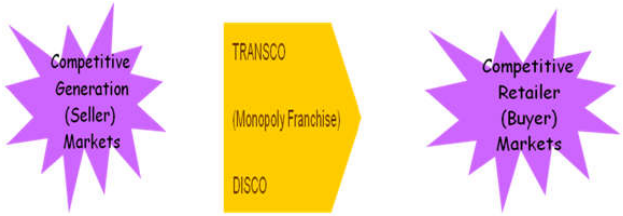

Fig. 6. Deregulation –Competition & Monopoly

Power Restructuring in India

Indian History of Power System

- Past-Indian Power system is more than 100 years old
- Till 1947-Fragmented small entities.
- 1948 -Electricity Supply Act –Vertically Integrated SEB's.
- Late 50's-Joint sector power plants involving states, associated transmission networks
- 1975-Central government entered into generation and transmission.
- Late 80's- Need for restructuring was felt
- Later- National Task Force and Regional Task Force formed by MoP
- Tariff rationalization report was examined by MoP and CERC approving the concept of ABT.
- July 2002 to-ABT was implemented region wise in a phased manner Nov 2003 through out the country.
- 2003-Electricity Act, replaces all previous acts.
- June 2005- Non discriminatory Open Access to be implemented.

Players in Restructuring Process

MoP – Ministry of Power
CEA – Central Electricity Authority
- Power planning at national level.
- Advices MoP on National Power Policy

CERC – Central Electricity Regulatory Commission
- Deals with regulatory issues at national level.

SERC – State Electricity Regulatory Commission
- Deals with regulatory issues at state level.

CSGS – Central Sector Generating Stations.
IPPs – Independent Power Producers. Established at both national and state levels
CTU – Central Transmission Utility. Nothing but POWERGRID.
SGS – State owned Generating Station – Genco.
STU –State owned Transmission Utility – Transco.
Discom –Distribution companies, state owned or private.
NLDC – National Load Dispatch Center

Duties: To facilitate inter-regional transfer of power for optimal scheduling among RLDC's

RLDC – Regional Load Dispatch Center

- NRLDC – Northern RLDC. HQ at New Delhi
- WRLDC – Western RLDC. HQ at Mumbai
- SRLDC – Southern RLDC. HQ at Bangalore

- ERLDC – Eastern RLDC. HQ at Calcutta
- NERLDC – North-Eastern RLDC. HQ at
- Shillong

Duties: Integrated operation of Power system in their respective regions. Optimal scheduling of Central Generation only. REBs to assist RLDCs
SLDC – State Load Dispatch Centers

Duties: Integrated operation of state grid. Optimal scheduling of state owned generation.

Main Features of Indian Power Restructuring

- Restructuring process started in 1990 by the state Orissa
- It is followed by A.P., Haryana, U.P.,Rajasthan and now in Maharashtra
- Unbundling of existing power industry into generation transmission and distribution sectors
- Opening the generation and distribution to private sectors
- Establishment of independent regulatory authorities
- Approval of Indian Electricity act 2003 in the Parliament which includes the various aspects of power restructuring.

Simplest Model of tomorrow's Power Industry

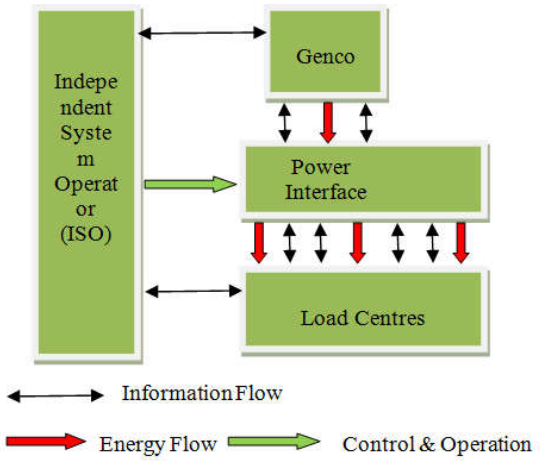

Fig. 7. Simplest Model of tomorrow's Power Industry

Electricity Market Mechanism

Three ways in doing so

- Poolco
- Bilateral Trading
- Power Exchange

Poolco

- Only one Buyer
- Govt. Agency
- Lowest cost bidder
- Buys enough power

Bilateral Trading

- Multi-seller/Multi-buyer
- Ind. Sellers & buyers make a deal to exchange power

Power Exchange

- Power Industry to establish trading exchange
- Buyers and Sellers enter their need
- Transaction with the PX
- PX constantly updates the MCP as like stock exchange
- Transaction takes place at MCP
- The multiple combinations of the mechanisms are used
- Implementation of these mechanisms can vary with the political jurisdiction

Restructuring Models

- Pool Model
- ISO Model

Basic Market Models

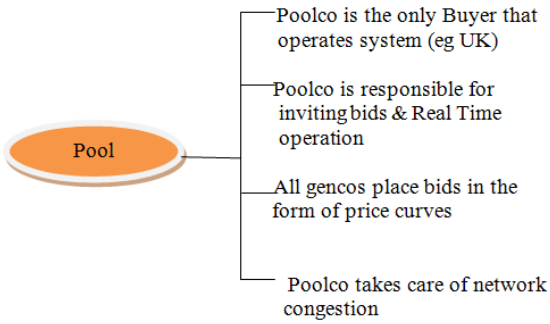

Fig. 8. Pool Market Model

Pool Model

- It is comprised of
  - Power providers
  - distribution companies
  - transmission companies
  - pool operator
  - Sellers and buyers submit their bids to inject power into and take out of the pool
  - It is adopted in Chile and also in England and Wales till 2000

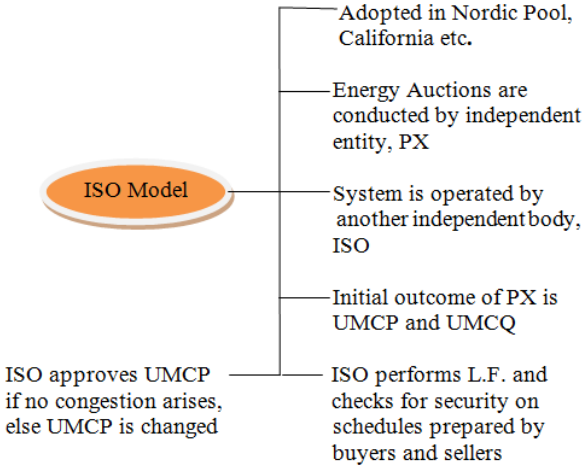

Fig. 9. ISO Market Model

ISO Market Models

- Functioning and ISO methodologies vary from market to market
- Accordingly structure of ISO model varies
- Common ISO Models are-
  - California ISO
  - Pennsylvania-New Jersey-Maryland (PJM) ISO
  - New York ISO
  - Electric Reliability Council of Texas (ERCOT) ISO
  - New England ISO
  - Midwest ISO (MISO)

Market Based on Contractual Arrangements

Bilateral Contracts Model

- It permits direct contracts between customers and generators without entering into the pooling arrangement.
- Buyers and sellers could directly negotiate in the marketplace.

Hybrid Model

- It combines various features of above two markets. Utilizing PX is not obligatory
- Customers are allowed sign bilateral contracts & choose suppliers
- It very costly to set up. It is adopted by California.

Important Issues in Deregulation

- Network Congestion
- Optimal Bidding
- Transmission Pricing
- Ancillary Service Management
- Risk Analysis and Hedging
- Network Congestion-

When the consumers and producers of electric energy desire to consume and produce the energy that would cause the transmission system to operate at or beyond one or more transfer limits.

Ways to tackle congestion

- Price Area C.M.
- OPF based C.M.
- FACTS devices based C.M.

Conclusion

- Deregulation is the need of hour.
- To bridge the supply-demand gap, enough generation capacity with proper planning will be required to be made available.
- Planning and controlling of transmission infrastructure is the most complex issue.
- In the initial stage of power restructuring, Transmission company has to operate in monopoly franchise.
- Role of ISO is most important.

REFERENCES

Commercial Practices Working Group, 1997. *"Industry Report to the Federal Energy Regulatory Commission on the future of OASIS"* Nov. 3.

Loi Lei Lai, *"Energy Generation under the New Environment"* a book on Power System Restructuring and Deregulation, John Wiley & Sons Ltd. Page 3

Loi Lei Lai, 2000. *"Chairman's Message"* IEEE International Conference on Electric Utility Deregulation and Restructuring and Power Technologies (DRPT 2000) 4-7.

Wilson, R. and Chao, H. 1987. *"Priority service: Pricing investment and market organisation"* American Economic Review, Vol.77, pp 899-916

****