

Deregulation in Power System to Improve the Power Quality with Different Models Formulated

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Abstract- The electricity power utilities in many countries have been, or are being, restructured. There are many reasons for restructuring. In some countries restructuring has been driven by the desire of government to meet increasing demands for electricity by encouraging independent power production, which relieves government of a financial obligation. In countries where ownership of assets are in private hands, restructuring has been driven by mergers and acquisitions, as companies seek to gain competitive advantage. In the most advanced countries, restructuring is being driven by the desire to allow consumers to choose their electricity supplier on the basis of price and service provided. These dramatic changes in the organization of electricity power utilities bring with them new challenges and opportunities, as the previous centrally designed and operated systems are dismantled and replaced by a new competitive framework. Companies operating in a competitive market need more sophisticated control and management systems to ensure that their business objectives can be achieved. The development and application of new technologies is also accelerated in this new environment, as companies seek to improve their effectiveness and efficiency. In this paper special considerations on power system deregulation are discussed. Main objectives of power system deregulation are to attract various investments to power industry in order to meet the fast growth of electric demand caused by blooming economy and in the meantime to reduce government commitment and functions in power industry. Only this way, the power industry, as a significant infrastructure, can realize sustainable development at high efficiency. It is also shown that in the market environment, how to realize optimal system planning and reliable operation at acceptable electricity prices with qualifies service and how to transit to the market environment smoothly at lowest costs and lowest risks should be considered thoroughly.

Keywords: - deregulation, Genco's, Transco's, discos, introduction, advantages, methods, cycles, importance.

I. INTRODUCTION

Deregulation is all about removing control over the prices with introduction of market players in the sector. However, this is not correct in a strict sense. An overnight change in the power business framework with provision of entry to competing suppliers and subjecting prices to market interaction, would not work successfully. There are certain conditions that create a conducive environment for the competition to work. These conditions need to be satisfied while deregulating or restructuring a system. Sometimes, the word „deregulation“ may sound a misnomer. „Deregulation“ does not mean that the rules won't exist. The rules will still be there, however, a new framework would be created to operate the power industry. That is why the word „deregulation“ finds its substitutes like „re-regulation“, „reforms“, „restructuring“, etc. The commonly used word in Europe is „liberalization“ of power industry; „deregulation“ is a more popular phrase in US.

If the power industries worked successfully with the regulated monopoly framework for over 100 years, what was the need for deregulating or changing the business framework of the system? There are many reasons that fueled the concept of deregulation of the power industry. One major thought that prevailed during the early nineties raised questions about the performance of monopoly utilities. This thought advocated that monopoly status of the electric utilities did not provide any incentive for its efficient operation. In privately owned utilities, the costs incurred by the utility were directly imposed upon the consumers. In government linked public utilities, factors other than the economics, for example, treatment of all public utilities at par, overstaffing, etc. resulted in a sluggish performance of these utilities. The economists started promoting introduction of a competitive market for electrical energy as a means of benefit for the overall power sector. This argument was supported by the successful reform experiences of other sectors such as airlines, gas, telephone, etc.

Another impetus for deregulation of power industry was provided by the change in power generation technology. In the earlier days, cost-effective power generation was possible only with the help of coal nuclear plants. However, during the mid-eighties, the gas turbines started generating cost effective power with smaller plant size. It was then possible to build the power plants near the load centers and also, an opportunity was created for private players to generate power and sell the same to the existing utility. This technology change, supposed to have provided acceleration to the concept of independent power producers, supported the concept of deregulation further. This technology change is supposed to have provided acceleration to the concept of independent power producers. This further supported concept of deregulation. This was specifically true where the financial losses were apparently high which was prevalent in some of the developing countries

II. BENEFITS

The competitive environment offers a good range of benefits for the customers as well as the private entities. It is claimed that some of the significant benefits of power industry deregulation would include:

1. Electricity price will go down: It is a common understanding that the competitive prices are lesser than the monopolist prices. The producer will try to sell the power at its marginal cost, in a perfectly competitive environment.
2. Choice for customers: The customer will have choice for its retailer. The retailers will compete not only on the price offered but also on the other facilities provided to the customers. These could include better plans, better reliability, better quality, etc.
3. Customer-centric service: The retailers would provide better service than what the monopolist would do.
4. Innovation: The regulatory process and lack of competition gave electric utilities no incentive to improve or to take risks on new ideas that might increase the customer value. Under deregulated environment, the electric utility will always try to innovate something for the betterment of service and in turn save costs and maximize the profit.

The power industry across the globe is experiencing a radical change in its business as well as in an operational model where, the vertically integrated utilities are being unbundled and opened up for competition with private players. This enables an end to the era of monopoly. Right from its inception, running the power system was supposed to be a task of esoteric quality. The electric power was then looked upon as a service. Control consisting of planning and operational tasks was administered by a single entity or utility. The vertical integration of all tasks gave rise to the term – vertically integrated utility. The arrangement of the earlier setup of the power sector was characterized by operation of a single utility generating, transmitting and distributing electrical energy in its area of operation. Thus, these utilities enjoyed monopoly in their area of operation. They were often termed as monopoly utilities.

Why were earlier utilities the „monopolies'? The reason for monopoly can be traced right back to the early days when electricity was comparatively a new technology. The skeptical attitude of the government towards electricity led to investment by private players into the power sector, who in turn, demanded for the monopoly in their area of operation. This created a win-win situation for both- government and the electrical technology promoters. However, the government would not let the private players enjoy the monopoly and exploit the end consumer and hence introduced regulation in the business. Thus, the power industries of initial era became regulated monopoly utilities. The structure of a conventional vertically integrated utility is shown in Figure 1.1. As evident from the figure, there was only a single utility with whom the customer dealt with. Thus, only two entities existed in the power business: a monopolist utility and the customer.

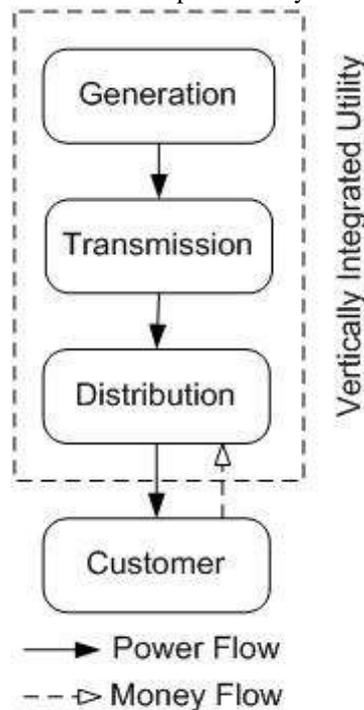


Fig 1.1

What does regulation mean? The regulations are generally imposed by the government or the government authority. These essentially represent a set of rules or framework that the government has imposed so as to run the system smoothly and with discipline, without undue advantage to any particular entity at the cost of end consumer. All practical power systems of earlier days used to be regulated by the government. This was obviously so. The old era power industries were vertically integrated utilities and enjoyed monopoly in their area of operation. Whenever a monopoly is sensed in any sector, it is natural for the government to step in and set up a framework of way of doing business, in order to protect end consumer interests. Some of the characteristics of monopoly utility are:

1. Single utility in one area of operation enjoying monopoly.
2. Regulated Framework: The utility should work under the business framework setup by the government.
3. Universal Supply Obligation (USO): Utility should provide power to all those customers who demand for it.
4. Regulated Costs: The return on the utility's investments is regulated by the government.

In a nutshell, regulation is about checking the prices of the monopolist in the absence of private players and market forces.

III. UNDERSTANDING THE RESTRUCTURING PROCESS

The restructuring process starts with the unbundling of the originally vertically integrated utility. This essentially leads to separate the activities involved in an integrated power system leading to creation of functional partition amongst them. For example, the unbundling of power industry involves separating transmission activity from the generation activity. Further, distribution can be separated from transmission. Thus, these three mutually exclusive functions are created and there are separate entities or companies that control these functions. Then, the competition can be introduced in the generation activity by allowing other private participants in this segment. In contrast to the vertically integrated case where all the generation is owned by the same utility, there is a scope for private players to sell their generation at competitive prices. The generators owned by the earlier vertically integrated utility will then compete with these private generators. The transmission sector being a natural monopoly is most unlikely to have competing players in the sector. This is because for natural monopolies like transmission companies, the business becomes profitable only when output is large enough. Figure 1.2 shows the representative structure of deregulated power system. In contrast to the vertically integrated utility structure, it can be seen that there are many alternative paths along which the money flows. It is evident that there are many more other entities present, apart from the vertically integrated utility and the customers. It should be noted that there can be many more versions of deregulated structure.

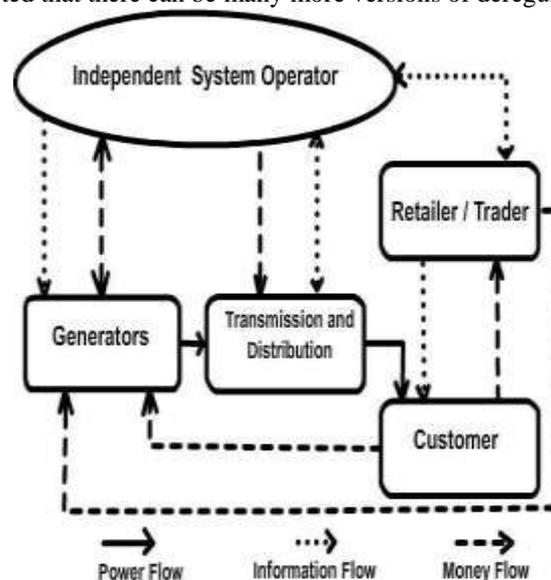


Fig 1.2

IV. ENTITIES INVOLVED IN DEREGULATION

The introduction of deregulation has introduced several new entities in the electricity market place and has simultaneously redefined the scope of activities of many of the existing players. Variations exist across market structures over how each entity is particularly defined and over what role it plays in the system. However, on a broad level, the following entities can be identified:

1. Genco (Generating Company): Genco is an owner-operator of one or more generators that runs them and bids the power into the competitive marketplace. Genco sells energy at its sites in the same manner that a coal mining company might sell coal in bulk at its mine.
2. Transco (Transmission Company): Transco moves power in bulk quantities from where it is produced to where it is consumed. The Transco owns and maintains the transmission facilities, and may perform many of the management and engineering functions required to ensure the smooth running of the system. In some deregulated industries, the Transco owns and maintains the transmission lines under the monopoly, but does not operate them. That is done by Independent System Operator (ISO). The Transco is paid for the use of its lines.
3. Discom (Distribution Company): It is the owner-operator of the local power delivery system, which delivers power to individual businesses and homeowners. In some places, the local distribution function is combined with retail function, i.e. to buy wholesale electricity either through the spot market or through direct contracts with Gencos and supply electricity to the end use customers. In many other cases, however, the Discom does not sell the power. It only owns and operates the local distribution system, and obtains its revenue by wheeling electric power through its network.
4. Resco (Retail Energy Service Company): It is the retailer of electric power. Many of these will be the retail departments of the former vertically integrated utilities. A Resco buys power from Gencos and sells it directly to the consumers. Resco does not own any electricity network physical assets.
5. Market Operator: Market operator provides a platform for the buyers and sellers to sell and buy the electricity. It runs a computer program that matches bids and offers of sellers and buyers. The market settlement process is the responsibility of the market operator. The market operator typically runs a day-ahead market. The near-real-time market, if any, is administered by the system operator.
6. System Operator (SO): The SO is an entity entrusted with the responsibility of ensuring the reliability and security of the entire system. It is an independent authority and does not participate in the electricity market trades. It usually does not own generating resources, except for some reserve capacity in certain cases. In order to maintain the system security and reliability, the SO procures various services such as supply of emergency reserves, or reactive power from other entities in the system. In some countries, SO also owns the transmission network. The SO in these systems is generally called as Transmission System Operator (TSO). In the case of a SO being completely neutral of every other activity except coordinate, control and monitor the system, it is generally called as Independent System Operator (ISO).
7. Customers: A customer is an entity, consuming electricity. In a completely deregulated market where retail sector is also open for competition, the end customer has several options for buying electricity. It may choose to buy electricity from the spot market by bidding for purchase, or may buy directly from a Genco or even from the local retailing service company. On the other hand, in the markets where competition exists only at the wholesale level, only the large customers have privilege of choosing their supplier.

V. DEREGULATION POLICIES ADOPTED IN THE OTHER COUNTRIES

The US

The US electric utilities, from the very beginning were privately owned and worked in a vertically integrated fashion. The developed countries like US had good functioning and efficient electricity systems. However for some systems, so long as consumers were concerned, they were not satisfied with the rising costs of electricity. For some other systems, utility management found that running the system was not viable due to low tariff. In some systems, pressure from smaller players to open up the business for competition played a major role. By and large, deregulation took place in developed countries by pressure to reduce costs while simultaneously increasing competitiveness in the market.

Existence of market power shows the signs of deviation from the perfect competition. In general, market power is referred to as ability of market participants to profitably maintain the market price above or below the competitive level for a significant period of time. To tackle the situation, an the indirect regulatory intervention in the form of market design rules is needed. Thus, as mentioned earlier, deregulation does not mean ceasing to have rules. It is the „restructuring“ of the power business framework. More rigorous treatment to these issues is given in further chapters.

The UK

The transformation of the British power sector proceeded along three paths in 1990. First, the traditional industry was unbundled both vertically and horizontally. High-voltage transmission assets were transferred to a new National Grid Company (NGC). Coal and oil fired units were divided among two companies National Power and PowerGen. Nuclear Electric retained control of all nuclear units. At the outset, National Power had

52 percent of total generating capacity, PowerGen had 33 percent, and Nuclear Power had the remaining 15 percent. The second set of changes involved ownership. Both National Power and PowerGen became private companies in 1991, whereas the difficulties associated with nuclear power resulted in continued government ownership of all nuclear units. Approximately 30 percent of shares in National Power and PowerGen were sold to the public, an equal amount to foreign and institutional investors. The remaining 40 percent was held by the government until 1995. The third set of changes sought to open the system to competition, wherever possible, while continuing necessary regulations. Vertical and horizontal restructuring of power generation was based on the assumption that generation had become workably competitive and would become increasingly so with new market entrants.

The Dde

The case of developing countries is different from that of other countries. In these countries, the electricity supply is treated as a social service rather than a market commodity. The ownership of the power sector in these countries is directly under the governments of respective countries. These state owned-controlled systems have led to the promotion of inefficient practices over a period. The power sectors of these countries are marked by supply shortages. There has been an inability to add to the generating capacity. The subsidies and high transmission and distribution losses are the major concerns before these systems. Another consequence of state control over electric utilities was the high level of overstaffing.

The inability to raise funds for capacity addition invited financial support from international financial institutions like World Bank. These institutions mandated opening of the power sector for private companies which were contracted under build, own, operate and transfer (BOOT) scheme.

VI. ORGANIZATION MODELS OF POWER UTILITY RESTRUCTURING

Electric energy can be separated commercially as a product from transmission as a service. In past, electricity viewed as a product used only at the point of delivery and paid for in a single tariff. In recent 45 years, restructuring and reengineering of power industry is taking place in several countries. The possible organizations differ with different functions of electric supply, namely Generation (G), Transmission (T) and Distribution (D) to the Customers (C).

1). Vertically Integrated: The vertically integrated model is also termed as monopoly at all levels". In this type of model, generation not subjected to competition and there is no choice of suppliers. A single company has monopoly of producing electricity and delivering it over the transmission network to distribution companies or customers. In a vertically integrated organization, the generation, transmission and distribution controlled by one utility.

2). Integrated Model: In this model, the generation and transmission functions are strongly coordinated on a long term basis. The generation and transmission entities are integrated or at least have cross ownership. The distribution can also be integrated to the generation-transmission utility. There exists a competitive integrated model where generation is open to competition, but independent power producers or Non-Utility Generators (NUG) have no access to the grid and can only sell to the utility to which they are connected on long-term contact basis. It is also termed as „purchasing agency model". A single buyer (purchasing agency) chooses from a number of 46 different generators to encourage competition in generation. Access to transmission is not permitted. Purchasing agency has monopoly on transmission network. A designated purchasing agency is allowed to buy from independent power producers. This introduces competition in power generation. This model avoids some costs of deregulated system: transaction costs of spot markets and transmission access, increased cost of capital when generators bear technology risk. It usually requires long-term contracts between the buyer and the independent power producers.

3). Open Access Model: In this, the integrated utilities exists but provision must be provided for grid access to independent power producer on non-utility generator either by wholesale wheeling where generators have a right to sell to other utilities (but not directly to consumers) generally on long term basis. This type of model is also termed as „wholesale competition model". Distribution or retail companies buy electricity directly from producer and deliver it over a transmission network. Distribution and retail companies still have monopoly over final consumers. There is open access to transmission lines. Distribution and retail companies authorized to buy directly from competing generators, but retain local franchise over retail customers. Generators must have access to transmission network, requiring trading arrangements for the network. In a wholesale access system,

the competition is expanded, where all generators can sell to 47 many customers. More buyers make the market more competitive and dynamic.

4). Retail Competition Model: This type of model is also called as „direct access model“, where all the customers can choose their own suppliers. There is open access to transmission and distribution lines. The distribution is separate from retail activity and later is competitive retail wheeling. Retail competition makes the most of competitive forces, by bringing all final consumers into the market. Retail competition also greatly increases transaction costs by requiring more complex trade arrangements and metering.

5). Spot Market Model: In this model, the generation and transmission entities are separated, there exists a „spot market“ organized by the transmission or grid entity under certain regulations where generators and consumers can compare their offers and demands. Spot market is only short term (a day ahead generally), and generators and distributors can have long-term contracts with consumers to generate the stability of prices.

6). Decentralized Generator Model: This model will come up in future with Decentralized Generation (DG) means (fuel cells, photovoltaic, wind, etc.), directly comes to distribution system or consumers. This model differs from each country depending upon objectives to fulfill are: a) To lower electricity costs, b) To guarantee security and quality of power supply, c) To seek private investment, d) To limit environmental consequences, e) To contribute to social and political objectives.

VII. CONCLUSION

Thus, deregulation in electrical power system calls for efficient, uninterrupted power continuity to the customers thereby crashing totally the monopolies. This system is not much popular in India, but soon this will start & encroach the existing system.

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