

## Module 7 : Power System Structures

### Lecture 32 : A vertically integrated utility

#### Objectives

In this lecture you will learn the following

- What is a vertically integrated utility?
- What are the conditions that have led to changes in the traditional power system structure ?

#### Power System Structure

Power systems traditionally have been what are known as "vertically integrated utilities". In this type of structure, one utility handles the all functions of generation, transmission and distribution within a certain geographical area. The operation and coordination of such a system is somewhat simple, since all functions are controllable by a system operator. The operational objectives were to provide quality power (voltage and frequency nearly constant) to a consumer, while ensuring reliability and overall economy (low cost).The price of power was "regulated" and based on actual costs.

An alternative is to treat power as a tradeable commodity. The functions of generation and in many cases, distribution, are open to private participation. While the "technical objectives" are similar to those in a vertically integrated utility, the price is not regulated, but depends on market forces and competition between the participants. In a generation deficit scenario, price may still need to be regulated. Alternatively, the amount of loads should be price sensitive or else prices will spiral upwards. The cost of use of transmission lines (to which all players will have "open access" subject to the transmission constraints) would also be regulated. Therefore a "regulator" would still be required. However, a regulator would be an independent body. An independent system operator would perform the co-ordination functions required to operate the system reliably and ensure that voltage and frequency are within limits. The real and reactive power resources required to maintain voltage, frequency and reliability may be "purchased" and charged to all the players in a fair manner.

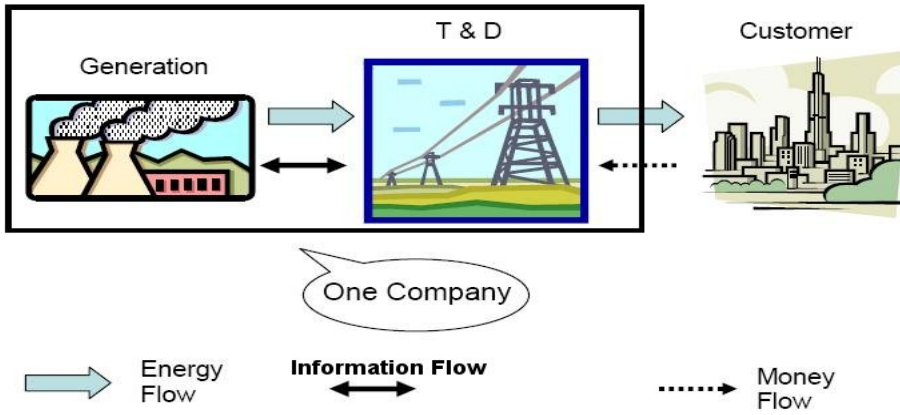
We shall discuss these structures and their impact on power system operation in the following lectures. We begin by considering in detail, a vertically integrated utility.

#### Structure of a traditional Vertically Integrated electric industry

The electric power industry has over the years been dominated by large utilities that had an overall authority over all activities in generation, transmission and distribution of power within its domain of operation. Such utilities have often been referred to as vertically integrated utilities. Such utilities served as the only electricity provider in a region and were obliged to provide electricity to everyone in the region.

The typical structure of a vertically integrated electric utility is shown in figure below. In the figure, the money flow is unidirectional, i.e. from the consumer to the electric company. Similarly, the information flow exists only between the generators and the transmission systems.

In vertically integrated utilities , it was often difficult to segregate the costs involved in generation, transmission or distribution. So, the utilities often charged their customers an average tariff rate depending on their aggregated cost during a period.



The state electricity boards (SEB) in India were examples of a vertically integrated utility; they are now being re-structured.

#### Characteristics of a traditional Vertically Integrated electric industry

Monopoly Franchise	Only the local electric utility can produce, move, or sell commercial electric power within its service territory.
Obligation to serve	The utility must provide service to all electric consumers in its service territory, not just those that would be profitable.
Regulatory Oversight	The utility's business and operating practices must conform to guidelines and rules set down by government regulators. The utility's rates are set in accordance with government regulatory rules and guidelines. The utility is assured a fair return on its investment, if it confirms to the regulatory guidelines and practices.

#### Why was a traditional electric utility industry structured the way it was?

During early days of the electric power industry, governments favoured a regulated monopoly - vertically integrated utility structure. The reasons are manifold:

This offered a risk free way to finance the creation of electric industry. Establishment of electric industry required large capital for infrastructure building. Thus for the purpose of risk minimization, a local monopoly and stable market was assured. The utility leaders could focus on building up their systems without having to worry about the competitors undercutting the prices to gain market share etc.

To prevent exploitation of consumers due to monopoly, the government brought in regulation.

This legitimized the electric utility business. Government franchises and regulation clearly implied to a possibly skeptical public that civic leaders thought electricity was a good thing.

It gave electric utilities recognition and support from the government, which was necessary to solve problems like 'Right of Way' (i.e. the "right" to an exclusive corridor to build a transmission line).

During the nineties, many electric utilities and power network companies world-wide have been forced to change their way of operation and business, from *vertically integrated* mechanisms to open market systems. This can be specifically observed in countries like UK, Sweden, Finland, Norway, US and some countries of South America. The reasons for change have been many and have differed over regions and countries. We shall study of these developments in the next lecture.

Conditions which are leading to changes in traditional power system structures

Basic motivation for changes in power industry scenario

There are many reasons that are leading to restructuring of power systems. One force was the change in generation economies of scale that occurred throughout the 1980's. Traditionally, electric utility systems evolved with the central station concept because of significant economy of scale in power generation. Very large generators produced power at less than half the cost per kilowatt of small generator units, and the bigger the generator, the more economical the power it produced. For the reasons stated below, the shift in economy of scale was observed:

Technological innovation improved the efficiency of small units for gas turbines, combined cycle, hydro and fuel cells over that of large ones.

Improvements in materials, including new high temperature metals, special lubricants, ceramics, and carbon fiber, permit vastly stronger and less expensive small machinery to be built.

Computerized control systems have been developed that often reduce the number of on-site personnel to zero.

Data communications and off-site monitoring systems can control the units from remote operations centers, where one central operator can monitor a dozen units at various sites, as if present at each.

Thus in *some* instances, it is possible to build new power plants that could provide energy at a lower price than what customers were paying. It became possible for the industrial and commercial users of electricity to build and operate their own plants also sell the excess power to small customers especially in generation deficit areas.

## The reasons for restructuring

The reasons for initiating the idea of deregulation ( **we will henceforth use the word *deregulation* to describe changes in power system structures; however, it will be clear that these changes involve changes in regulations rather than deregulation!** In some countries, these changes are also described as "liberalisation") in power industry are many.

Following are the main reasons:

### 1. The need for regulation changed.

More fundamental than any other reasons for change was the fact that the basic needs for regulation of electric industry had died away before the end of 20<sup>th</sup> century. First, the original need for regulation, which was to provide risk free finance to build the infrastructure, did not exist anymore. Second, most of the the major electrical infrastructure was paid for, decades ago. The revenues gained by the electric utilities was invested to renew their system, and the level of risk in doing so was less as compared to that existed in the initial era. Being a proved technology, the risk involved in investing money in such a technology was nullified. The electricity could now be thought of as an essential commodity, which can be bought and sold in the marketplace in a competitive manner, just like other commodities.

### 2. Ideological Reason : Privatization

Usually the motive was the government's firm conviction that private industry could do a better job of running the power industry. This belief, of course came from better privatization experiences of the other industries. Deregulation does not necessarily have to be a part of privatization efforts.

### 3. Cost is expected to drop

Competition is expected to bring innovation, efficiency, and lower costs.

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### 4. Customer focus will improve

Although monopoly franchise utilities have an obligation to serve all customers, that does not promote the proactive attention to customer needs. A monopoly franchise utility listens to its customers when they explain their needs, and then responds. A competitive electric service company *anticipates* customer's needs and responds in advance. The technological advances that will be applied under deregulation, address customer service. More important gain of competition in the electricity market is the customer value rather than lowering the cost.

## 5. Encouragement for innovation

The regulatory process and the lack of competition gave electric utilities no incentive to improve on yesterday's performance or to take risks on new ideas that might increase customer value. If a new idea succeeded in cutting costs, the utility still made only its regulated rate of return on investment; if it didn't work, the utility would usually have to 'eat' a good deal of the failed attempt, as imprudent expenses. Furthermore, why would a regulated utility want to use new ideas to lower its costs under a regulated rate of return framework?

Under deregulated environment, it was felt that the electric utility will try to innovate something for the betterment of service and in turn save its costs and maximize the profit. By means of this, the utility will try to ensure that it will maintain its customer base in spite of competition.

## Recap

In this lecture you have learnt the following

- What is a vertically integrated utility
- The structure of a vertically integrated utility
- Both technological and economic reasons have lead to changes in the traditional power system structure
- Congratulations, you have finished Lecture 32. To view the next lecture select it from the left hand side menu of the page.