REFORMS IN POWER SECTOR FOR DEVELOPING COUNTRIES
ISSUES AND OPTIONS
A CRITICAL STUDY

A DISSERTATION

Submitted in partial fulfillment of the requirements for the award of the degree

of

MASTER OF TECHNOLOGY

in

HYDROELECTRIC SYSTEM ENGINEERING AND MANAGEMENT

By

NUTAN PRAKASH SHARMA

WATER RESOURCES DEVELOPMENT TRAINING CENTRE

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

ROORKEE-247 667 (INDIA)

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CANDIDATE'S DECLARATION

I hereby declare that the work, which is presented in the dissertation entitled: **"REFORMS IN POWER SECTOR FOR DEVELOPING COUNTRIES: ISSUES AND OPTIONS-A CRITICAL STUDY"** being submitted by me in partial fulfillment of the requirement for award of degree of **MASTER OF TECHNOLOGY IN HYDROELECTRIC SYSTEM ENGINEERING AND MANAGEMENT** at the Water Resources Development Training Center (WRDTC), Indian Institute of Technology Roorkee India, is an authentic record of my own work carried out during the period from May, 15,2003 to June21,2004 under the supervision of Prof. Devadutta Das, W.R.D.T.C I.I.T Roorkee and Prof. V.K Nangia, Department of Management Studies I.I.T Roorkee.

The matter embodied in this dissertation has not been submitted by me for the award of any other degree or diploma.

Sharma

Place: Roorkee **(Nutan Prakash Sharma)**

June,22,2004

This is to certify that the above statement made by the candidate is correct to the best of my knowledge.

Devadutta Das

Prof. V.K Nangia
Department of Management Studies
Indian Institute of Technology
Roorkee-247667 Uttaranchal
India

Prof. Devadutta Das
W.R.D.T.C
Indian Institute of Technology
Roorkee-247667 Uttaranchal
India

SUMMARY

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CONTENTS

SUMMARY

It is a fact that no country can abstain from the present worldwide pressure of *"Power Sector Reform"*. Even International Financers (World bank\IMF\ADB) and Donors are now putting the sector reform as a pre-condition to finance power related projects. The inspiration might have been strong, as there happened many examples of success than failure of new market functioning in the contemporary world.

The pre-reform condition of energy sector prevailed in the developed country (who successfully restructured the sector) could not match as that of the developing country. Once the present vertically integrated utility system gets dismantled, it should function in the sought manner and be it in a sustainable way with least disturbance and any challenges coming a head should have a feasible solutions.

The study attempts to address some of the challenges faced by developing countries towards power sector reform. The student is of the view that what has been done by developed countries cannot be fully copied and implemented in the developing country. Some sub-models and approaches can be suitable for the power sector at the brink of transition.

It is realised that the process of reform is a long and complex process, the steps on the way to reform may have to be taken more gradually and the design of the market should, at least initially, be relatively less complex than in some developed countries.

As first and most pre-requisite of energy sector reform is the existence of professionally capable and independent Regulatory Regime. The Regulatory Commissions (RCs) should be independent from the government politics, power sector stakeholders and even with the consumers. Government must cease to intervene in regulatory matters, expect for policy directives. Each and every possible mechanism needs to be established and practiced ensuring Regulatory Independence.

Regarding distribution sector, the private investors would be interested in the urban/city areas, as they would be able to predict the risks much better and generate faster impact in terms of reduction in losses and other efficiency improvement targets. The distribution system in the urban areas are likely to be better understood than that in the

rural areas in terms of load density, the number of consumers and losses and other financial projections.

The isolation of the mainstream operations from rural operations and adopting a co-operative-take-over is considered a viable approach.

To act as an umbrella organisaton, to oversee and promote the formation of Rural Electric Co-operatives (RECs), plan and undertake rural distribution facilities, prepare operating/functioning rules, compare and evaluate the running of such co-operatives, there shall be a Rural Electric Co-operative Board (RECB) at the center. It shall be acting as a regulator once the owner ship, and O&M is taken by the local co-operatives.

The Rural Electric Co-operatives (RECs) shall have full right as that of a bulk consumer to purchase power from the nearby distcos at the bulk price set by the Electricity Regulatory Commission (ERC) or directly from the wholesale market or having a bilateral contract with gencos depending upon their size and location.

It has been suggested that the introduction of a monthly varying adjustment tariff within a REC gives a strong incentive for the consumer/member to control theft and losses and also complete billing.

It seems appropriate to propose that the Government should provide direct subsidies, if it desires, over the bulk price that RECs are paying for the supplier or to any other category of consumer's tariff within RECs/distcos jurisdiction.

When the rural electrification gets separated from the mainstream, the existing subsidy/cross-subsidy from non-rural consumer to rural consumer gets removed. An appropriate "Rural Electrification Tax" needs to be designed and enforced for gencos, distcos, and captive generators as well. Such tax shall go directly to a Rural Electrification Fund (REF) and then to RECB or such.

Keeping in view of the above findings and other matters it is desired to propose that the generation sector be first unbundled and privatized leaving transmission and distribution as a single entity (T&D) and creation of System Operator, SO (of course Independent) having the duty of load dispatch center too. For the time being, SO shall be embedded with the T&D entity i.e. Transmission and Distribution Company (TDC).

The generation sector should be unbundled in to several possible generation companies (gencos). If all the generating plants cannot be fully privatized at the time, then some can remain as a public company running completely in a commercial principle having full efficiency and revenue sufficiency. This concept can be applicable for the distribution sector as well. Further such move shall help manage the unwilling-staff-take-over by the private investors along with other liability attached with the employees of the utility.

The gencos shall bid into a day ahead WSEM. It is suggested that four-hour duration shall be the time slot for initial years (or it could be assessed after a detail study of daily load curves and whence 1-hourly or so can be decided).

It is hoped that practice of bidding initially makes gencos learn to live with the new system arrangement and know how to construct their offers in order to achieve their commercial objectives

In the earlier period the TDC shall be *a single buyer* from the gencos and existing IPPs, gencos bidding in a day ahead wholesale market. Until the separation of Distribution Business TDC shall be doing the work of Market Maker, System Operator, Grid Operator and Distribution Service as well.

Considering the requirement of continuous increase in the transmission expansion in the developing countries, RoR Regulation with profit sharing seems appropriate for the regulation of TDC/TSO.

Depending upon the nature, area, size and population, a selective approach of distribution privatization shall be adopted. Provision of acquiring a single distco, multiple distcos, public distco and distribution co-operative needs to be analyzed and studied.

Distribution wheeling needs to be allowed even before going to have an open access. Some large customers (3-phase or 11 k.v and above), who can have (afford) time-of-use meter as per wholesale market duration, can take power watching the price signal in the market paying the distribution wheeling charge for the distcos contained.

It can be proposed that once distco's status becomes financially sound and technically capable, consumers can be allowed to choose other supplier distcos in their zone. The one distcos can supply power to a consumer in other distco's area paying it the wheeling charge.

Keeping in view that a large number of small customers do not have capability of keeping time-of-use meters, and other logistical complexities, Retailers (energy supplier without owning the distribution wires) are not supposed to be there at least in initial years.

For the transition period rate of return regulation or performance-based regulation shall be the basis for distcos (all types) regulation. Then after price-cap-regulation can be applied for the zones having multiple distcos; which shall be an incentive for a sort of retail competition as well. For a monopoly distcos (single distcos in an area) "rate of return regulation with profit sharing" or "Yardstick Regulation" seems better suitable.

Strict and clear-cut service conditions and complaint handling rules shall be designed and enforced with provision of penalty for the responsible entity (defined by the regulator)

The whole process of privatization and restructuring needs to be guided by a philosophy of transparency, in order to satisfy the needs of public opinion, legislative requirements and expectations of potential investors and other stakeholders.

Initially the wholesale electricity market (WSEM) as a single buyer should be formed at the time of unbundling generation (into several gencos as private gencos and even as public gencos).

The IPPs needs to be integrated with the WSEM operation giving them the option of i) voluntary negotiation and entering into bidding and / or go for bilateral contracts with the demanders (distcos\large customers\RECs) ii) or remain where is as is basis with their own PPAs (may be watching the new market behavior) and selling power to the Transmission and Distribution Company (TDC).

It is suggested that the monopoly entity, TDC, shall not exist for a long time. It should be in a dynamic transition. Further the unbundling of distribution sector shall start at the earliest and transmission-wheeling charge too finalized at the same time. From the time of creation of distcos, they shall purchase energy from the wholesale spot market or have bilateral contracts with any of the gencos or IPPs.

The wholesale purchase price (WPP) shall be based on System Marginal Pricing. Alternatively Successive Pricing can be the next option.

Bilateral Contracts shall be allowed from the very beginning of WSEM. By use of which, distcos\customers\RECs can establish various service contracts with any supplier in order to obtain the lowest rate and most desirable service.

It is hoped that suggested design of 'Forward Contract' and 'Option Contract' evolves as an efficient financial mechanism to hedge the various risk foresighted by the players.

When the power sector reform nears completion, the distribution sector will be fully separated from the Transmission and Distribution Company (TDC) leaving it as a Transmission and System Operation entity (TSO). The distcos, large consumers and rural electric co-operatives (RECs) all can have the options of purchasing energy from the spot market or can have bilateral contracts with gencos and\or IPPs.

It is foresighted the journey of power sector reform shall have two modes:

(a) A model in transition with TDC

(b) An advanced model with TSO

The structure and components of these models are self explanatory and depicted in the concluding chapter 8.0

Actually the power sector reform brings different expertise into close contact; engineers who like to operate sophisticated power systems, economists who like to think about optimal incentives, and lawyers who like to write rules and agreements. But unless these experts work together in designing sustainable institutions, all of them will fail at their chosen task. Last, not the least, there should be a strong political will of the country to go ahead with sector reforms with accountability and transparency at proper levels.

CHAPTER 1.0

INTRODUCTION

1.0 INTRODUCTION

1.1 General:

It is widely recognised that electricity boosts economic growth, and hence is vitally important to the development and welfare of nations. Because of its versatility, convenience, and relative ease of transport, it makes possible many of the goods and services that we associate with modern life.

Developed nations typically have very high levels of electrification, and over the last hundred years electricity has gradually replaced other forms of energy to operate industrial and commercial processes, as well as becoming increasingly predominant in the household sector. From electric lights, electric motors, and microwave ovens, to television, telephones, and computers, electricity has become a critical input supporting a wide range of consumption, transportation and production activities.

Traditionally, power utilities have been state-owned monopolies or privately owned monopolies, either regulated by government agencies or "self-regulated" without much oversight. Their mission has been engineering one: expanding supply, improving technical efficiency, and ensuring or improving reliability and access.

In developing countries, many utilities have been and remain are in poor financial condition and have limited borrowing ability to make investments and expand service. In developed countries, utilities had been considered among the safest investments available, since their profits were guaranteed by government regulation, and thus had no trouble attracting capital for expansion.

During the 1990s, power sector reforms sped up over utilities worldwide, with profound effect on technologies, costs, prices, institutions, and regulatory frameworks. Restructuring has changed the traditional mission and mandates of utilities in a complex way, and has had large impacts on environmental, social, and political conditions.

The reforms and consequent restructuring being attempted in the power sector (including the introduction of private sector and more specifically the multinational sector), is itself a sequel to "globalization and the liberalization of the economy"

Power-sector restructuring is underway or beginning in many regions and countries around the world, both developed and developing. Restructuring is resulting in independent power production and competition in generation; decentralization; privatization; unbundling of generation and transmission; and even competition in distribution. Along with these changes are a broad variety of new institutional and contractual forms within the power sector.

Although privatization efforts differ substantially from country to country, there is a strong common economic rationale underlying the various decisions to privatize state energy resources. In general, nations have privatized state-owned electricity industries to achieve one or more of the several objectives. These objectives include:

- raising revenue for the state
- raising investment capital for the industry or company being privatized
- reducing government's role in the economy
- promoting wider share ownership
- increasing efficiency
- introducing greater competition and
- exposing firms to market discipline

As mentioned by *S.Hunt and G. Shuttleworth* [10]:

"In the context of power sector reform several questions beg for answers. For example, what would be the long-term policy with respect to privatization of the electrical power industry? Would profit maximization be the main objective? Would independent power producers be allowed to sell power directly to select consumers? Would the State Run Electricity Undertakings be handed over to the private sector at some book value? Would the market dictate tariffs or would tariffs be based on profits guaranteed to the investors\MNCs or would they be based on the people's capacity to pay? Who would provide the subsidies for those living and operating at the margin?

Would the people be given a choice between affordable power with power cuts during peak hours and high priced un-interrupted and reliable power?"

Whatever may be the reason, one needs to know their alternatives and the implications of a change.

Restructuring of electricity sector started in the 1980s in Chile and then in UK and spread to the Latin American countries and accelerated in the 1990s in diverse forms in USA, Australia, Nordic countries and a number of Asian countries.

Restructuring of the power sector is a very complex exercise based on national energy strategies and policies, macroeconomic developments and national conditions and varies from country to country. There is no single solution applicable to all countries and there is a broad range of diverse trends.

Regulatory systems are put in place to control costs and prices and to make investment decisions. Once it has been shown that competition is feasible, the question must arise as to whether it would make sense to introduce it and how much to introduce.

A complete design of competitive electricity market is a complex exercise that is influenced not only by economic and engineering considerations but also by historical, political and social constraints as well.

It is known that competition forces market participants to be more aware of their own profits. In simple economic terms, the profit consists of two parts: *revenue and cost.*

From the supplier point of view, decreasing costs or increasing revenue shall increase the profit. A decrease in costs will be possible when the supplier can achieve higher efficiency from its existing assets. An increase in revenue will be possible when the supplier can expands its customer base.

From the consumer point of view, an increase in profit is directly related to finding an alternate supplier who can offer the same service at a lower price or so.

1.2 Need of the study:

It is a fact that no country can abstain from the present worldwide pressure of *"Power Sector Reform"*. Even International Financers (World Bank\IMF\ADB) and Donors are now putting the sector reform as a pre-condition to finance power related projects. The inspiration might have been strong, as there happened many examples of success than failure of new market functioning in the contemporary world.

The pre-reform condition of energy sector prevailed in the developed country (who successfully restructured the sector) could not match as that of the developing country. Once the present vertically integrated utility gets dismantled, it should function in the sought manner and be it in a sustainable way with least disturbance and any challenges coming a head should have feasible solutions.

Power Sector Reform and its aspects attached are much vast in itself and many research works are going on with specific focusing on Congestion Management, Market Design, Pricing Methods etc in the context of new emerging markets.

It is generally impossible to cover the whole area deeply in a single attempt. Attentions have been made to focus and converge onto the chosen topic itself.

Mainly the entire study involved issues regarding:

- Regulatory bodies and their role
- Form of regulation for privatized utilities
- Chronology of deregulation of the sector
- Prevailing subsidies and rural electrification
- Development of Wholesale Electricity Market
- Transition from the present to the new stage

Attempt has been made to address the issues as far as possiHe.

It is aimed that, ultimately, the study can bring out a sustainable ***"Power Sector Reforms Model"*** addressing various issues like Rural/Agricultural electrification, subsidies and other social obligation etc.

Power Sector Reforms case studies and activities of different countries like India, Nepal, Bangladesh, Philippines, Argentina, U.K etc. has been studied in very detail as far as possible. Also references are made with the related articles available in journals, newspapers etc.

1.3 Organization of The Dissertation:

As first and most pre-requisite of energy sector reform is the existence of professionally capable and independent Regulatory Regime. Chapter 2.0 deals with utility regulation and regulatory commission in brief. Issues regarding the generation sector and its unbundling, generation planning in new environment etc. is covered in Chapter 3.0

It has been aimed that distribution privatization should be carried out only after the isolation of rural electrification from the mainstream. Generation sector is considered as a first step for unbundling (into several gencos) leading to the existence of Transmission and Distribution Company (TDC). These modalities are discussed in Chapter 4.0.

The viability and organizational outline of rural electrification by introducing Rural Electric Co-operatives is brought out in Chapter 5.0. Chapter 6.0 deals with the aspects on distribution sector.

Wholesale Electricity Market (WSEM) structures and models are presented in the chapter 7.0 Integrating all the concepts and correlating all the remarks of the preceding chapters over all conclusion is presented in the concluding chapter 8.0

A brief summary of case studies of Power Sector Reforms in Delhi (India) and U.K has been presented in Appendix-1 and Appendix-2 respectively.

CHAPTER 2.0

UTILITY REGULATION AND REGULATION

2.0 UTILITY REGULATION AND REGULATORY COMMISSION

2.1 General

The start of utility regulation differs greatly from country to country. However, the fundamental needs for governmental oversight of the utility sector are universally accepted.

The primary economic rationale for regulation is that the electric industry is an important industry that, which has a measurable share in a country's total national output. Electric power is an essential input to many other industries and has a significant influence on the size and growth of the entire economy a country. It constitutes a large part of the infrastructure uniquely prerequisite to economic development. The power sector's outputs are essential to the well being of society, including households and businesses.

The Objectives can be:

- To improve efficiency in the industry
- To prevent misuse of electrical energy
- To build investor confidence to attract investment
- To build consumer confidence
- To address public policy goals

The most important step in any electric utility restructuring is to clearly understand and workout the country's goals and constraints. Such goals may include the following:

- Having a financially viable and sustainable electricity industry
- Attracting private capital
- Maximizing public revenues from the sale of government owned assets
- Reducing cost and tariff of electricity
- Creating an environmentally sustainable electricity sector

- Achieving efficiency improvements and greater benefit for consumers; and
- Expanding the distribution network so that all can have access to electricity

Constraints, due to government policies or external circumstances, are equally important to know and they may generally include the following.

- Existing prices subsidized for some customers (cross-subsidies) while others are overcharged
- Post-reform rapidly increasing prices may be politically and practically impossible.
- National security or economic condition may compel the use of local resources
- Major reductions in the workforce may not be possible, even though the pre-reform employment levels may be well above of those that a competitive sector would support.

Since electric utilities generally do not operate in competitive markets that would impose cost discipline upon them, regulation must fulfill that function. This objective is promoted by setting rates that reflect, to the greatest extent possible, the marginal costs of production. In addition, the regulatory regime should promote policies that result in the efficient operation of the utilities to produce prices that resembles the outcomes of a competitive market.

The prices should be fair to both consumers and investors. The price regulation is intended to guard against the reaping of economic profits while still enabling the utility to generate revenues adequate to cover prudent expenses and investment and to provide a reasonable return on that investment.

Abuse of Market Power:

Market power is the ability of a supplier to raise prices above competitive levels and/or restrict output below competitive levels for a sustained period of time, for the purpose of increasing its profit. If a market does not have effective competition, it can yield a market price that is well above a competitive price level.

In the generation market it is the ability of one or more generators to raise the price above competitive levels for a sustained period of time because there may not be enough competition in the market in a given geographic area. Again, the level of market power depends on the number, size, cost, and ownership of the generators in the given geographic market. Market power needs to be examined in energy, capacity and ancillary service product markets too.

The mitigation measures may include adding new capacity by diverse owners, adding more transmission capability into the area and adding demand responsiveness to the load (i.e., load is reduced by customers if prices increase, thus limiting the ability of the abuser to raise prices).

The electricity products that are provided by owners of generation that may be subject to market power include energy, capacity and ancillary services (including operating reserve, VAR support, load following and black start capability). The regulators should, in their decision making process, ensure that legitimate interests of investors are not compromised.

As per the *Regulation Theory* [12]:

- Investors need a fair and transparent regulatory process that they believe would afford them a fair chance to make their case and the results would be based on merits of their arguments.
- In addition, there should be a fair judicial process in the country, to address legitimate grievances of the investors, should they be unhappy with the regulatory decisions.
- The regulatory system should ensure nondiscriminatory access to service for all consumers. This includes access to physical infrastructure as well as affordable power supply. The regulatory process should be fair and transparent to all stakeholders. The regulatory process should be structured in such a fashion that it engenders consumer confidence in the process and the outcomes.

As utilities are affected with "public interest" and are also monopolies for the most part, most aspects of utility operations are regulated by the government or regulator. Regulator is a lawful authority charged with the responsibility to regulate the industry so as to be run in an efficient, economic and competitive manner while retaining its public interest character. The regulator has to protect the interests of the consumer, the investor, the government, and other stakeholders. The challenge is to balance the interest of the stakeholders in a manner where the utility's rights can be protected while also protecting the interest of the consumers.

Despite efforts to introduce competition by inviting the private sector to participate in infrastructure activities, the electricity market structure has retained a largely monopolistic character. Governments in the developing countries continued to have a significant ownership in these sectors and remained the custodians of consumer interests, while at the same time trying to provide a level playing field to new investors. The multiple and conflicting roles of the government highlighted the need for a separate regulatory body that would maintain an arms length relationship with all service providers and stakeholders, including the Government. These considerations provided the rationale for a new type of regulation, often called independent regulation, in most countries including India.

2.2.0 Issues:

2.2.1 Regulatory independence

Regulatory independence is a subject that is most debated in the regulatory community. A regulatory authority is neither an administrative body nor a judicial body. Its functions cannot be called administrative, as it is required to take consultative and transparent decisions, while administrative decisions are generally opaque. Similarly, it cannot be called a judicial body as the regulator is required to balance interest of various stakeholders during the regulatory process, and does not simply apply rules to facts, as in the case of judicial bodies.

CHAPTER 3.0

GENERATION SECTOR

According to *Smith Peter L* [14] regulatory independence may mean that regulators should have:

- An arm's length relationship with regulated firms, consumers and other interests
- An arm's length relationship with political authorities
- Organisational autonomy

Independence, in context of the developing countries, should mean that the regulator should have all the above characteristics, and the autonomy so that they can apply its expertise in accordance with the mandates provided.

Hearing:

Fair hearing is a rule of universal application and is a duty lying upon everyone who decides any thing. Where natural justice is violated there is no justification to say that the decision was in fact correct. A proper hearing must include a fair opportunity given to each contending party to comment upon and to correct and or contradict any thing prejudicial to their view. Regulators will need to develop a good understanding of the issues, and when they should act and shouldn't act.

Records of every proceeding except those confidential or privileged or specifically exempted are to be open to inspection by any person or party either during or after the proceeding.

Decisions:

In deciding upon the procedure principles of natural justice must be followed coupled with sufficient stages in the process to receive all the necessary information for the purported decision. The decision must not be more drastic than it is necessary for attaining the desired result (The doctrine of proportionality).

The Regulators needs to establish legitimacy by successfully defending their decisions subjected to appeal and review.

2.2.2 **Financial Autonomy:**

As regards the financial autonomy of the RC in most of the countries, it seems that RCs have to work as any other department of the Government where every item of expenditure has to go through an approval process. There exists the control of the administrative ministry/the finance wing of the government through allotment of funds, issue of sanction orders, procedures for spending, drawing of bills, accounting and auditing, etc.

Generally, two separate models are present for the funding of RCs: the "charged" mode of financing the RC and a "Fee-based" Mode. In the former case, the budget of a RC is provided from the state Fund. This mode does not eliminate completely the interference from the executive while determining the size of the RC's budget. In the "fee" based funding system, the RC's fund is based on the fees charged on the regulated parties.

2.2.3 Selection of regulators

On the issue of an effective selection process, there are different approaches being adopted across the world. The executive and the legislature jointly decide the appointment of regulators in countries like USA and Argentina. In the UK, it is the executive that selects a regulator. In India, in the power sector and in Nepal in the telecom sector, a committee prepares a panel of names at first instance for consideration by the executive.

Ideally speaking a regulator should be chosen through a transparent process for attracting the best available expertise in the field.

The regulators should be bound by a strong ethical code. As per the *Regulation Theory* [12] the key components of such a code include:

•Prohibition against any ownership, gratuity or other material economic interest in the regulated utility;

•Prohibition against any ownership, gratuity or other material economic interest in any consumer or consumer group affected by any commission decision;

•Prohibition against *ex parte* communications with parties in a pending matter; and,

•Prohibition against political influence or interference.

Because no regulatory commission exists prior to restructuring, the commissioners and its staff may be initially be drawn from within the electric sector. While this may be necessary and, indeed, it is equally desirable for the new commission to establish its independence from the industry it regulates.

Creation and activation of the new commission should be viewed as one of the *first* steps in power sector reform. Existence of commission very early in the process makes it able to gain important and timely first-hand experience with the industry it will be regulating. In addition, this allows the commission to establish, develop, and implement its independence from the utility. This is very important because of the regulatory commission's broad public interest mandate.

Key Characteristics of a Regulatory Commission

The structure, scope and powers of a regulatory commission are very important for a successful restructuring of the industry. The key characteristics of a good regulatory commission include:

•Independence from the political process;

•Independence from the regulated enterprise;

•A broad mandate to protect the public interest;

•Technical expertise in the functions and business of the regulated enterprise; and,

•Continuing monitoring and enforcement of rules and orders.

2.2.4 Other issues are:

- Should the regulator be re-appointed?
- Should he/she take employment in the regulated entity after retirement?
- Should the number of regulators be more than three (as in India) considering the new challenges and responsibility including power sector reforms?
- Should the RC be allowed to hire expertise at market rates?
- Should there be Parliamentary / legislative committee to oversee the regulatory activity?

2.3.0 Conclusions:

The Regulatory Commissions (RCs) should be independent from the government politics, power sector stakeholders and even with the consumers. Each and every possible mechanism should be established and practiced ensuring Regulatory Independence.

Public Hearings and access to information should be made compulsory. The Annual Reports and Activities of RCs should be submitted to the concerned Parliamentary Committee. This ensures public accountability of RCs.

The Budgetary support should be from the government side but with greater flexibility on RCs expenditure (such as hiring of expertise at market rates etc.).

Some sort of fees, collecting from the regulated entities, does not seem to comply with the general public's sentiment (in our socio-politic conditions) for an independent RC (we can imagine what happens if, for the purpose of autonomy, courts are allowed to charge fees for the Justice they are rendering).

There should be provision that the RCs chairman and member could be re-appointed after their tenure and can be allowed to take employment in the sector other than they served.

Utilizing the gained professional experience by the experts can be beneficial to a country. However it should not be meant that the regulators shall be re-appointed in all the circumstances.

Keeping in view of the new challenges and responsibility including power sector reform, the number of regulators should not be restricted to three, there could be more than three persons.

3.0 GENERATION SECTOR

3.1 General:

Electricity generating Power Plants are the most important part of a electricity market as they form the foundation block for Cost of Energy to be paid by the end use consumers. Competing production cost, efficient running, reliability and adequate capacity are the main objective of a sustainable power sector.

The present scenario in the generation sector is such that there is a mixture of utility owned power plants, IPPs, distributed generation and captive generation. The study and analysis is centered around competitive bidding by the generators in the day a head market (chapter 7).

The question is how to introduce competition among the existing (to be privatized) plants and the new entrants.

The Advantages of Competitive Generation

Competitive generation envisions a market within which independent firms compete on the basis of price to sell electricity directly to large industrial customers (bulk wheeling), and to supply electricity, via common carrier transmission, to distributors who in turn sell power to final users. Producers may specialize or diversify by load characteristic. For example, some may prefer to compete for long-term base-load contracts. Firms with fossil fuel plants might seek to supply base and cycling loads. Finally, producers with gas combustion turbines and co-generators could compete to meet peak loads. Other firms may diversify and be ready to compete for base, cycling, and peak loads. Peak and off-peak loads can be defined by day, week, and season.

As postulated by *J.C Moorhouse* [6] there are a number of advantages to having a variety of types of generators linked to the transmission grid:

- The first major advantage involves cost savings. At any given moment, power is supplied to the transmission grid by the firm with the lowest marginal costs. Dispatch according to merit (from lowest to highest marginal cost including line loss) saves resources and reduces the cost of generating electricity. Because the different plants may have different load characteristics, peak and load duration curves, generating capacity can be more fully utilized and additional capital resources saved.

Moreover, the variety of generating equipment and the larger number of independent producers adds diversity to the system, lowering the probability of widespread equipment failure, and, thereby, reducing the amount of excess capacity required to provide a given level of service reliability. The availability of electricity from alternative suppliers means that generators can coordinate routine plant maintenance. The added flexibility in scheduling repairs lowers plant maintenance costs too.

The above four sources of cost savings mean lower prices to the consumers of electricity

- The second advantage of competitive generation is that a spot market for electricity will develop. The ability to sell electricity on the spot market increases the generator's flexibility in scheduling production. Moreover, the presence of a spot market means that less idle capacity must be maintained in order to provide a given level of service reliability. Shortfalls and emergencies can be met by purchasing power on the spot market. Demand and supply are equilibrated by flexible spot prices.

- The third advantage of competitive generation is that the market will provide an array of service standards that more closely match the mosaic of consumer preferences.

- The fourth advantage of competitive generation is innovation. Experience in the electric power industry suggests that competitive pressure tends to make industries more innovative. Competition not only leads firms to be more responsive to consumer demands, monitor costs more closely, and compete on the basis of price, it provides an incentive to be innovative because that may be the only way to get a temporary jump on rivals.

3.2 Options in the generation sector: The most of the country (and many Indian states) practiced so far, towards unbundling, is the creation of a single (giant of course) Genco, owning all the generating plants the utility had. To achieve the objectives of power sector reform, there should be competition among the generating plants as well as competition to construct generating plants.

3.2.1 Competition to construct generating plant:

Three broad options, or models, are sighted:

1. Central planning - the state utility or government plans future capacity and the competitive element can be tenders to construct or to construct, own and operate. The management of social issues and fuel diversity is simplified - the risk is bureaucracy.
2. Constructor's free choice - both fuel and technology is chosen by the constructor. The output can be sold to a central purchasing agency, direct to the customer, or a pool.
3. Hybrid - there is a plan and tenders to fulfill it as in 1 above, but also no restriction on other plant being built. Where investor interest is inadequate to fulfill the plan, the state commissions the plant, ensuring that there is always the planned capacity.

3.2.2 **Creating Competition in Generation:**

Merely having two Gencos and full-fledged reform in u.k shown that the Gencos have achieved market power in generation bidding. Market power refers to conditions where the providers of a service can consistently charge prices above those that would be established by a competitive market. Later they were to split further. From lessons and experience, the *Australian Reform* created five generating companies and so by *Argentina* also (forty gencos).

The World Energy Council (WEC) has also postulated that there should be many competing generators – the exact number depends on the similarity of the competing generating plant. As price setting occurs throughout the full demand range, there need to be competitors at every demand level. *The WEC* study suggested that, for plants utilizing the same fuel source and with similar cost structures (rarely the case in reality), five competitors may be sufficient and that, for dissimilar plant, no competitor should represent more than 10% of the total capacity. Others suggest that even greater numbers are required for effective competitive conditions to apply.

3.2.3 Unbundling:

WEC observed that: "In reality, electricity industry reform involves a continuing process of structural and regulatory change. One of the biggest blunders in electricity industry reform may have been to approach reform as though it involves a single structural step, or series of steps, rather than a continuing process.

Clearly, no *"magic wand"* approach is appropriate for reforming such a vital sector of the economy as electricity. If a particular country is starting from the position where its entire electricity industry is owned and operated by a state monopoly, it should be expected to take at least ten years to get to the point where an industry made up of fully competitive private sector participants is operative."

The process of reform is a long and complex process. It should commence with the drafting, in a participative manner, of realistic national objectives and with the laying down of a reform road map. With a realistic road map, policymakers can monitor the implementation of the reform process and modify the regulatory regime as experience is gained and as markets change and new market evolves.

This will mean that the steps on the way to reform may have to be taken more gradually and the design of the market should, at least initially, be relatively less complex than in some developed countries.

Unbundling options:

(a) Unbundle three sectors all at once (generation, transmission and distribution): most of the countries and many Indian states.

(b) Start with Transmission not generation: as per *WEC's* guidelines.

(c) Unbundling first generation only and creation of Transmission and Distribution Company (TDC) at the same time and then leading to TSO: a new approach (detail in next chapter)

3.3 Conclusions:

It is desirable to propose that the generation sector be first unbundled and privatized leaving transmission and distribution as a single entity (T&D) and creation of System Operator (of course Independent) having the duty of load dispatch center too. For the time being, System Operator shall be embedded with the T&D entity. If the necessity warrants, representation of gencos and IPPs could be incorporated in the System Operator to ensure neutrality.

Unbundling the generation sector first shall minimize the complexities involved in the other prevailing approaches of creating gencos, transcos and distcos all at the same time and the complexity coming with the liability apportioning, valuation and the stranded costs.

These approach is preferred keeping in view that distribution sector shall be separated only after the rural co-operatives, community based organizations and /or local bodies take over the operation and maintenance and low level expansion of rural power supply.

Further there shall be created maximum number of generating plants (gencos) each do not exceeding 10% of the total capacity. These gencos shall bid to the single buyer (at this stage) in a day head market (chapter 8.0).

If all the generating plants cannot be fully privatized at the time, then some can remain as a public company running completely in a commercial principle with inherited liability, if apportioned from the utility.

As per the study done by *"Prayas Pune"* the generation costs constitute about 60% of the end user tariff when are transmission costs constitute 10 to 15%. Indicating that cost of inefficiency in transmission is much less than the benefits of generation inefficiency.

The IPPs shall be integrated with the wholesale market (detail in chapter 7) giving them the option of voluntary negotiation for entering in to bidding as by other gencos or remain as is where basis and allowed for bidding for the excess of contracted energy/capacity in the market.

To have competition in construction of generating plants hybrid model of planning (*observed by WEC*) seems most appropriate for the developing power markets.

As far as possible merchant power plants shall be encouraged to come up in the system. Distributed Generation (DG) should be encouraged for the expansion of electricity coverage and rural electrification. They shall remain under the regulatory regime. The DGs could be an electric energy (Renewable as well) source connected directly to the local distribution network or load center, which are decentralized and located closer to the point of use, making greater economic and environmental sense.

Many countries are to de-license the generation sector (except nuclear and hydro). Merely de-licensing and sitting idle may be dangerous for developing countries because sufficient number of generating plants may not come up in right time as the power market may not be much attractive as from investor point of view.

So procuring IPPs (through competitive bidding) or continuing even government investment cannot be ruled out completely. System load forecast and generation planning must be well available to the market players and Government/Regulator must be well aware of the above situations.

It seems relevant to propose that some legal provisions, at appropriate level, be made such that *"power sector emergency"* can be enforced and the government intervention in the market be sought for a short time to overcome the type of crisis as that of California Power Crisis or any other National Contingency that may arise. Even in such emergency, it should be ensured that, there should not be any adverse financial effects for the market participants due to the state intervention for a shorttime.

CHAPTER 4.0

TRANSMISSION SECTOR

4.0 Transmission Sector

4.1 General:

The electric transmission system is one of the most complex man made systems. At the transmission level of the power system, primary service is to move the power from generating point to the point of use. Establishment of rules for operating the transmission network (technical issue) and providing access and pricing services (economic issue) are the real challenge. Transmission pricing influences the decisions of both generators and consumers and affects the development of the electricity industry over time.

The power sector reform is expected to offer benefit of lower electricity price through competition, improved system efficiency and better consumer services and choices too. However it poses several technical challenges with respect to the conceptualization and integrated operation. Basic issue of ensuring economic, secure and stable operation of the system, while delivering power at desired quality in terms of voltage magnitude and frequency, have to be addressed carefully in the new market which are likely to become more complex as compared to the present monopolistic situation.

An important question that needs to be addressed before restructuring the electric industry is regarding the market model to be adopted. The model should not be directly copied from those existing in the other countries. Rather a careful study should be done to evolve a model suitable to the specific situations in a country and that it should be feasible and easy to implement and sustain then after.

The Transmission System is a natural monopoly in the Economic, the geographic and the technical sense and therefore must continue to function as a regulated entity.

4.2 The Basic Framework:

The steps on the way to reform may have to be taken more gradually and the design of the market should, at least initially, be relatively less complex than in some developed countries.

The outcome of this entire study conceptualizes a "unique Model" (chapter 7), which shall be evolved at the final stage of reform transition. Before arriving at the model, the generating sector needs to be separated from the existing utility leaving transmission and distribution entity (T&D) as a single organization at the starting stage (also see chapter 3).

At the same time there shall be created a System Operator (of course Independent) merging the duty of load dispatch center. For the time being, SO shall be embedded with the T&D entity. If the necessity warrants, representation of gencos and IPPs could be incorporated in the SO.

The T&D Company (TDC), purchases power from gencos by bidding process thereby creating a day ahead wholesale purchasing spot market (chapter 7). The IPPs may bid (voluntarily) or continue with their PPAs. This company shall be regulated by the principle of Rate of Return Regulation with Profit sharing for the service it provides.

Then after the distribution sector shall be separated and privatized in a selected way (chapter 6). The operation, and to some extent the expansion, of rural electrification shall be done by rural co-operatives, community based organization or local bodies. Before the start of privatization of distribution sector, wheeling charge needs to be finalized. In the last stage, after the privatization of distribution sector and creation of Rural Electrification Co-operative Board (chapter 5), the TDC will emerge as a Transmission Provider and System Operator or simply TSO. Open Access, explained later, shall be given only then after.

4.3 Role of Transmission and Distribution Company (TDC):

The life of Transmission and Distribution Company shall be Transitional till it downsizes to Transmission and System Operator (TSO). Until the separation of Distribution Business TDC shall have a greater role and be doing the work of Market Maker, System Operator, Grid Operator and Distribution Service as well.

The main roles and responsibility of TDC shall be:

(1) Power delivery or ensuring the required transmission services.

(2) System Operation and Security functions i.e. to ensure stable, secure and economical operations of the power system. This includes procurement of ancillary services, congestion management, if arises, and dispatching functions.

(3) Plan transmission (and if required distribution as well) expansion and ensure that resources for future investments are generated.

(4) Works related with Distribution Business.

(5) Whole sale spot market operator

(6) Clearance of the payback for gencos and IPPs as per the price settlement agreement.

(7) Transmission Pricing or wheeling charge calculations and filing to regulator.

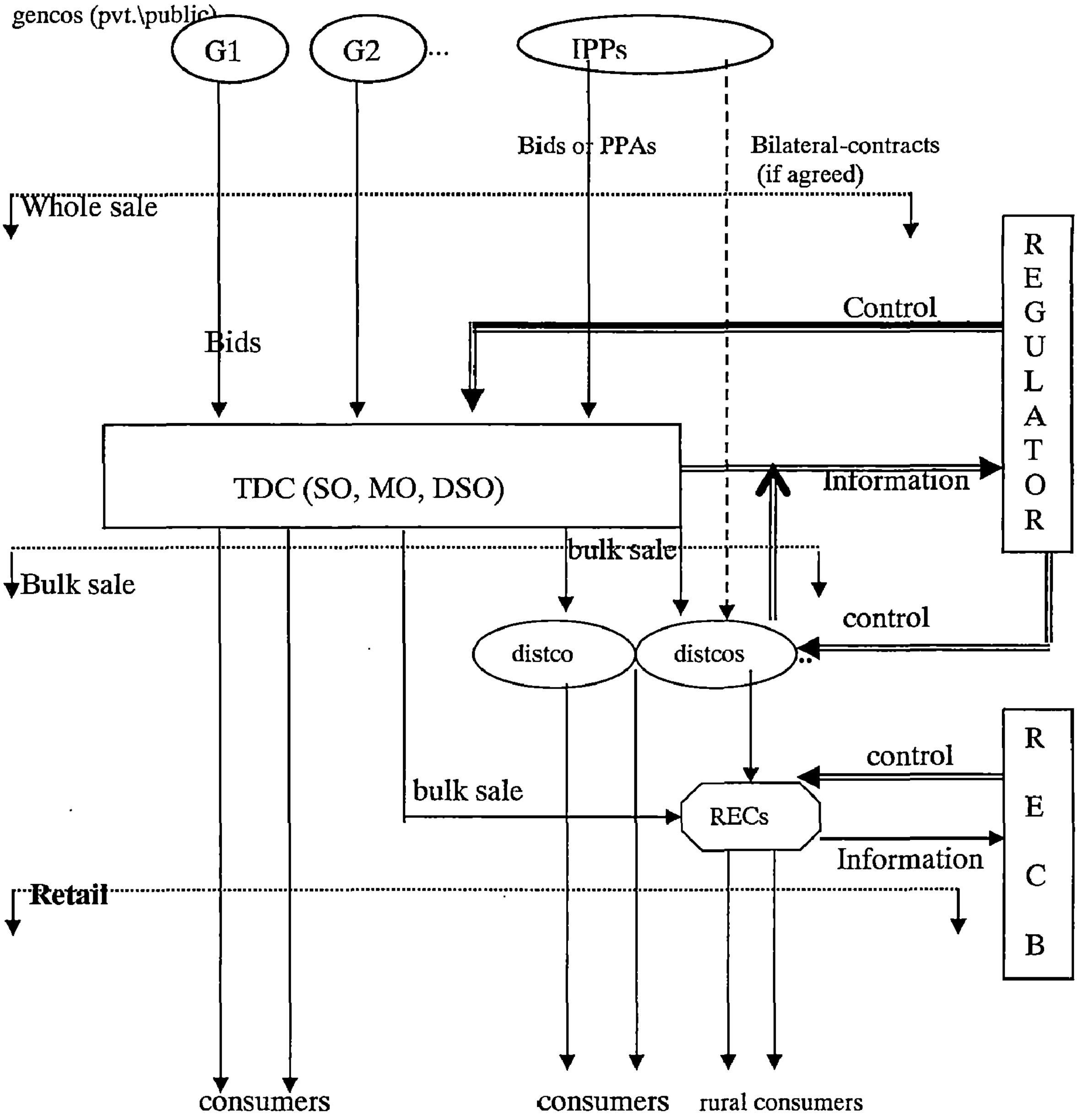
(8) Facilitate the concerned authority for the formation of different types of distribution companies (see chapter 6 page...) and allow them to take power from the wholesale market.

(9) Allow Bilateral Contracts (if IPPs agree, between IPPs and the distribution companies too).

(10) Assure Open Transmission Access and Energy Market-Co- ordination

The function 10 comes after the downsizing and becoming a TSO. The other major role shall be playing an important facilitator for the government and the regulator during the privatization of the distribution sector.

The model look like:



The Network Model During Transition

4.4 Evolvement of TSO:

When distribution sector is freed up (having several distcos, rural co-operatives) Transmission and Distribution Company shall be converted to TSO.

Over the past 12 years, separate transmission system operators ("TSOs") have been created or proposed in more than 30 countries reforming their power sectors. Two kinds of operators dominate: transcos and independent system operators ("ISOs"). Transcos are joint owner-operators of the high-voltage grid. Independent system operators are separate operators of grid facilities owned and maintained by others, such as vertically integrated power enterprises or stand-alone owners of transmission facilities usually referred to as wirecos.

ISO model is practiced in those countries in which sufficient numbers of nearly equal sized transmission companies exist in the market and some even provide generation and distribution in their local areas.

However there is no rigid requirement, in the context of open access, to separate transmission ownership and operation. TSO inherited from TDC (TDC inherited from the Utility) will have many resources, including a large staff of experienced power system operators and engineers, a fully computerized control center, and a massive remote data collection system in hand to monitor, analyze, and control the entire network.

Therefore creating a separate ISO, in a developing country, seems to increase the transaction cost, so a properly designed TSO shall serve the purpose.

The TSO shall be a neutral entity responsible for maintaining the instantaneous balance of the grid system. TSO performs it function by controlling the dispatch of flexible plants to ensure that loads match resources available to the system. Another major responsibility of TSO is to ensure fair and impartial access to transmission system for all generators, while maintaining reliable operation.

Transmission Operator is the supreme entity in the control of transmission network. It should remain dissociation from all other market participants and absence from any financial interest in the generation and distribution business.

The job of the transmission system operator is to ensure the electrical stablity of the interconnected system so that bulk power can be transported from generators to distribution networks. The operator provides open access to the transmission system, monitors and controls system operations to ensure a moment-to-moment energy balance, manages congestion, schedules generation (or reviews the technical feasibility of schedules submitted by others), acquires ancillary services such as operating reserves and voltage support, and plans or approves requests for maintenance of transmission and generation facilities. Many system operators also administer spot and real-time balancing energy markets. These operators generally perform metering, accounting, settlement, and billing for the markets.

Before going for open access the gencos shall be mandatory to bid in the power pool. Regarding IPPs, the option is to apportion progressively the existing PPAs to different distcos. Once this is achieved the resulting structure would lead to the open access environment.

4.5 Open Access:

The Open access shall be provided only after the wholesale spot market matures and sufficient operational experiences stabilize and also the IPPs are ready terminating PPAs and going for power pool or have bilateral contracts (other than with TDC\TSO. Here the buyers and sellers have option of entering in bilateral transactions or be participants in the energy auction market (power pool).

The transmission price (section 4.6), for the bilateral contracts too shall be same as that of others. In case any bulk customer (or captive generator) finds the TSO's transmission charge high compared to building alternative transmission facility, first priority shall be given to a separate private transmission company to build such lines and it should also need to provide access to others if capacity permits. Second priority may be to allow the needy to build own and operate the transmission line. Such steps may help to create pressure of competition to the TSO.

4.6 Transmission Pricing:

The transmission price plays an important role in the success of power sector reform since it determines whether the provided transmission services are economically beneficial to both the wheelers and the customers. The main objectives of charging the transmission service are economic efficiency, revenue sufficiency and efficient regulation.

The associated several costs are operating cost, capital recovery cost (including sunk costs), cost of marginal losses, cost of constraints (see congestion4.7) and system expansion costs.

The various types of transmission services under open access are:

(a) Entry service: service provided to a generator to transport electricity to the transmission network

(b) Exit service: service provided to a customer to receive electricity from the transmission network.

(c) Energy transport service: service provided to the generator, customer or another person in relation to electricity transport along the transmission network.

(d) Common system service: services related to power system functioning and maintenance of system security, benefiting all customers which use the transmission system and which cannot reasonably be allocated depending on the customer's location on the power network;

(e) Connection service: service related to establishing the initial connection to a generator or customer or transformation thereof.

4.6.1 Methods or Options of transmission pricing:

(a) Flat Fee Method: This is the simplest method to adopt in which the transmission charges are equally distributed to amongst all the customers irrespective of their use of the network. The drawback is that the charges become unfair to those customers who consume lesser amount of electricity.

(b) Postage Stamp Method: In this method, transmission prices are charged equally on per MW basis irrespective of the supply and delivery points. In this scheme a customer drawing same amount of power as another one but located farther from the source point is charged same transmission price, whereas its use of transmission network is more.

(c) MW-Mile Method: The pricing in this method also considers the distance involved in transaction apart from the amount of power being transported. The distance may be aerial or circuit length.

(d) Nodal Pricing Method: The most complicated but accurate pricing method is nodal pricing derived from incremental (marginal) cost theory. If MP_i and MP_j are the marginal nodal prices of electricity at bus i and j, the marginal transmission price is MP_i - MP_j and is measure of what it costs the grid to accept an additional unit of power at *i* and deliver it to *j*.

4.7 Congestion management:

Congestion (also called "line congestion") is the condition, which pertains when the available capacity of a transmission line is being closely approached (or exceeded) by the power that is sought to transmit through it. At such times, alternative power line pathways (or local generators near the load) must be used instead. Congestion need not actually be occurring: the TDC\TSO need only believe that it may occur at a defined time in order to declare a line congested, thus forcing others wishing to use it to resort to alternatives means of power delivery. The normal condition is when all pool demand and all bilateral transactions are dispatched without system security violations.

Not all requests for transmission can actually be accommodated just by increasing flow and losses. The transmission system suffers from some major constraints: thermal limits, voltage limits, transformer emergency ratings and stability limits. Whenever the physical or operational constraints in the network become active, the system is said to be congested. In other words, Transmission Congestion is defined as the condition where there is insufficient transmission capability to simultaneously implement all Preferred or Revised Schedules that Market operator submit to the SO in the forward markets.

The objective of congestion management is to minimize the interference of the transmission network in the market and at the same time to ensure the secure operation of the power system. Any control measures adopted by the system operator to eliminate/minimize congestion must not only be technically justifiable, but also be fair to users and commercially transparent.

The TSO should create a set of rules that ensure sufficient control over producers and consumers to maintain an acceptable level of power system security and reliability in both the short term and long term (transmission building) while maximizing market efficiency.

Regarding system expansion in due course of congestion management, *Sally Hunt and Graham Shuttleworth* [10] postulated that:

> *"A transmission request may be accommodated in the first instance by increased losses. As power flows increase beyond a certain limit, security and other standard dictate that generation be backed off in the export constrained zone. When more request for transmission starts receiving, there comes a point where the discounted present value of all losses and constraints on the system as presently configured, integrated over all hours of system use, and projected into the near future, rises above the minimum cost of alternative system with new lines added. The marginal cost of transmission at this point must include the cost of system expansion.*
>
> *The economic rules for system expansion are as follows:*
>
> *(a) Only build additional capacity if total savings in the cost of generation (and load management) exceed the total generation costs.*
>
> (b) *Add capacity until the marginal generation savings equal the marginal cost of building additional capacity."*

Whenever a generator is constrained on for its dispatch due to transmission congestion, the TSO shall be made to pay, the difference between the Pool Price at that instant and the generator's offer price, as long as the generator is dispatch able. Such incidents should be reported to the regulator as well.

A regulatory solution needs to guarantee that the private incentives of the transmission network owner and market participants reflect the social value of their decisions. Appropriate transmission investment will reduce capacity constraints on the grid. If there are no constraints, then there is no need for investment. If there are constraints, however, the key regulatory issue is how to give the network owner the incentive to invest in the grid at the appropriate time. *Sappington and Sibly* [11] show

how an *incremental surplus subsidy (ISS) scheme* can align the private and social incentives.

"When a monopoly TSO undertakes a relevant regulatory activity, the above scheme awards the monopolist the entire social surplus from that activity for one regulatory period. In other regulatory periods, the monopolist is regulated on the basis of costs. The intuition behind the ISS scheme is that optimal decisions are often based on marginal gains and losses."

4.8.0 Regulatory Aspects of the Transmission Sector:

Electricity transmission requires regulation because it embodies a natural monopoly technology. It is efficient to have a single system to provide transmission, so long as the owner of that facility can be prevented from exploiting monopoly power. Regulation is often used to constrain the owners of natural monopoly facilities and many standard solutions, including price-caps, rate-of-return regulation and public ownership, are used around the world to deal with the conflict between efficient production and abuse of market power. Further the regulatory regime should design and enforce efficient incentive schemes that help cost minimization of the firm.

4.8.1 Types of Regulation:

(a) **Rate of Return Regulation:** Rate-of-return (RoR) regulation is also called cost-of-service regulation in that it essentially allows companies to pass through those costs which are deemed necessary by the supervising regulatory body to ensure that an adequate level of service is provided to end users. During periodic regulatory reviews, expenditures that are deemed appropriate by the regulatory body are added to the rate base. In order that appropriate levels of capital investment are undertaken, supervising regulatory bodies estimate appropriate rates of return for the regulated utility, based in part on the cost of capital to the utility.

The objective of rate-of-return regulation is to ensure that prices are set at a level that allows ongoing supply of the goods or services in question (including investment) by the regulated firm, but are not set so high as to allow excess profits. It refers to any arrangement that restricts the earnings of a firm to be no greater than the cost of providing the regulated service. The defining feature of this form of regulation is that the returns accruing to holders of equity in the regulated entity are directly proportional to the amount of capital deemed to be in use by that entity. Thus, at least in theory, rate of return regulation can offer the firm a full insurance against variations in income.

Berg and Tschirhart [2] characterize this rate setting process as using the following three steps:

- The firm's costs are reviewed, and costs deemed to be unnecessary are eliminated
- A rate-of-return judged to be fair for the firm is specified
- Prices and their structure are set to generate enough revenues to cover costs and provide a fair rate of return.

Thus, at least in principle, the cost of providing fixed assets required for the production of regulated services is fully refunded under rate of return regulation.

Problems with Rate of Return Regulation:

Under the purest forms of rate of return regulation, in which regulated revenues are held to a level just sufficient to cover allowed costs, the regulated firm has no incentive to become more efficient by reducing its costs. Provided full cost recovery is guaranteed, neither shareholders nor managers gain any advantage from streamlining production systems or investing in more efficient technologies. The result is that, although prices reflect costs, these costs are not as low as they might otherwise be and the company may gain excess profits.

As mentioned by *Martin R. Pardina* [9] the above problems can be addressed as:

> *"The Regulator can pass these savings (excess profits) on to consumers in the future, but the incentive depends on allowing the firm to earn higher profits for a time. Further the regulator would use a prediction of the firm's costs to set prices, and would then monitor the actual costs."*

Other possible compromise, suggested by *Ian Byatt*, a British regulator, is that the regulator allow the firm to "bank" the resulting revenue (almost as a kind of capital investment), adding it to the next periods allowable revenue and smoothing out the firms profit stream. Including all the above concepts, the regulation is also known as "RoR regulation with profit sharing".

(b) **Price Cap Regulation (CPI-X):**

This method originated in the UK where it was most famously used for controlling British Telecom following the opening to competition of telephony markets in that jurisdiction. Compared with other incentive regulation schemes, the basic idea of a price cap is particularly simple, though an ideal implementation of the concept is far from simple.

A price cap is generally imposed for a period of three to five years. Within that period, prices may change, but only in accordance with the terms or formula set out at the beginning of the period.

The general structure of the formula is as follows:

$$(\text{PRICE})_{\text{Year 1}} = (\text{PRICE})_{\text{Year 0}} * [1+(\text{CPI-X})] +/- Z$$

Where CPI is a measure of inflation, X a productivity factor, is an adjustment to the inflation factor adjustment, and Z refers to unforeseen costs that may arise or disappear. Utilities are often allowed to price below the price cap, though lower limits are sometimes imposed to prevent anti-competitive practices.

The price caps may apply to the utility's average price, to average prices for each customer class, or to each rate element of each rate schedule.

Under a price cap, revenue growth is based on sales growth combined with the inflation factor.

Inflation Factor: There are many measures of inflation. In addition to the consumer price index, CPI, other familiar indices are the producer price index (PPI), the retail price index (RPI), and change in the gross domestic product (GDP). None of these is especially good at explaining historical or projected differences in utility costs. Nor are these indices useful in describing utility revenue growth.

Productivity Factor, X: The main purpose of the 'X' factor is to adjust the inflation factor (whatever it may be) so that the resulting multiplier, (CPI-X), produces a reasonable level of revenue growth or a reasonable level of anticipated cost growth. Thus, most regulatory practices have approached the issue by comparing trends in specific inflation indices to the utility's total cost trends. Such analysis of the total factor productivity identifies how utility costs have been controlled relative to inflation.

Exclusion Factor, Z: Exclusions, often called Z factors, are items excluded (either in whole or in part) from the operation of the price cap regulation. Examples include changes in income tax or other laws, changes in environmental laws, changes in financial accounting standards or other accounting rules. *Z* factors are the primary mechanisms used to allocate risks. Any cost subject to a *Z* factor means it is a cost, or a risk, that the utility will not bear. For instance, if the corporate income tax rate changes while the price cap regulation is in effect, a Z factor could permit the utility to pass the effect (which may be positive or negative) onto consumers. The price cap regulation could state that the *Z* factor becomes effective only if a tax rate change is greater than a specified level, thus creating a sharing of the risk.

CPI-X regulation is also often called "performance-based regulation" in that it seeks to achieve economic efficiency through altering the incentive structure of the industry.

The longer is the tenure of the cap, the greater incentive the firm has to cut costs immediately. However, even if a long tenure is used, as the review date approaches the incentives change for the firm. Now it wants to look like a high cost firm because this will lead the regulator to reset the cap at a higher level. Cost reduction incentives are strongest if the cap is never reset. In this case, the firm is a residual claimant on all cost savings indefinitely and will therefore devote an efficient amount of effort to improving profitability through cost cutting. However, such an approach may become politically untenable if the firm earns huge profits at any stage.

Since a compensatory return on necessary capital invested is required to avoid bankruptcy, price-cap regulation cannot be implemented without considering, at least implicitly, the regulated firm's rate of return. *Bergman et.al.* [1] put it this way:

"In practice, [rate of return] regulation and price cap regulation are not too dissimilar. This is because when setting a price cap, the value chosen for X takes into account a firm's rate of return."

© Yardstick Regulation:

In yardstick regulation the performance of a regulated utility is compared against that of a group of comparable utilities.

For example, the mean of the costs of a peer group of firms can serve as performance benchmark. If several companies are regulated together, the regulator may be able to make "yardstick" comparisons among them. If all the firms face the same/similar type of operating conditions, so that they could, in theory achieve the same level of costs, the regulator can calculate the average cost that they achieve (either over the whole group or among the more efficient companies) and set prices based on this level. Each company then has an incentive to reduce its costs.

This method was first proposed by *Shleifer* [13] and can be used to promote indirect competition among regulated utilities operating in geographically separate markets.

4.9 Conclusions:

During the start of the reform process the existing utility shall evolve as a Transmission and Distribution Company (TDC), generation being separated (gencos). This approach has been proposed keeping in view that: a) the subsequent privatization of distribution sector be fruitful after establishing a competitive wholesale electricity market (WSEM), b) separating the rural electrification and formation of rural co-operatives and/or ownership by local government bodies to take over the operation and maintenance and low level expansion of rural power supply.

For the time being the TDC shall be *a single buyer* from the gencos and existing IPPs, gencos bidding in a day ahead wholesale market (four hourly duration). Until the separation of Distribution Business TDC shall be doing the work of Market Maker, System Operator, Grid Operator and Distribution Service as well.

It is wise to accept the fact that power sector reform process should be continuous, smooth and gradual and the design of the market should, at least initially, be relatively less complex than in some developed countries.

Once the separation and privatization of distribution business is over, then TDC shall emerge as a Transmission and System Operator (TSO). Unlike in some developing countries having a separate Independent System Operator (ISO), Transco and Market Operator (MO), the TSO shall be embedded with such functions having units of TO, SO and MO.

TSO inherited from TDC (TDC inherited from the Utility) will have many resources, including a large staff of experienced power system operators and engineers, a fully computerized control center, and a massive remote data collection system in hand to monitor, analyze, and control the entire network.

Further, ISO model is practiced in those countries in which sufficient numbers of nearly equal sized transmission companies exist in the market and some even provide generation and distribution in their local areas.

Therefore creating a separate ISO, in a developing country, seems to increase the transaction cost, so a properly designed TSO shall serve the purpose. If the necessity warrants, representation of gencos and IPPs could be incorporated in the SO to assure neutrality.

The Open access shall be provided only after the wholesale spot market matures and sufficient operational experiences stabilize and also the IPPs are ready terminating PPAs and going for power pool or have bilateral contracts (other than with TDC/TSO).

As long as the transmission sector remains as a public monopoly, Postage Stamp Pricing method needs to be adopted. There shall be a capacity charge (per MW) and an energy charge (per MWh).

The transmission revenue requirement would be computed line-wise and combined together for all lines owned by the TDC/TSO, for the calculation of transmission charges.

In case any bilateral contract holder, including only those distcos operating in an area enjoying retail competition [allowing for other distcos may give rise to situation of *self dealing* at a later stage such as they may claim to review the retail tariff sighting the transmission network operating cost etc.], finds the TSO's transmission charge high compared to building alternative transmission facility, first priority shall be given to a separate private transmission company to build such lines and it should also need to provide access to others if capacity permits. Second priority may be to allow the needy to build own and operate the transmission line. It is hoped that such moves may help to create pressure of competition to the TSO.

TDC\TSO shall implement, if congestion arises, a proper congestion management method after a through study and modeling of the system. Whenever a generator is constrained on for its dispatch due to transmission congestion, the TSO shall pay, the difference between the Pool Price at that instant and the generator's offer price, as long as the generator is dispatch able. Such incidents should be reported to the regulator as well.

Considering the requirement of continuous increase in the transmission expansion in the developing countries, *RoR Regulation with profit* sharing seems appropriate for the regulation of TDC/TSO.

CHAPTER 5.0

CO-OPERATIVES and RURAL ELECTRIFICATION

5.0 CO-OPERATIVES and RURAL ELECTRIFICATION

5.1 General:

The study is concerned with the aspect of rural electrification coming under the connection of national grid/distcos/utilities; aspects of isolated supply etc. are not included here though they can be integrated as required in local condition.

In many cases, most subsidized rural electrification schemes have been run by high-cost, centralized public utilities charging tariffs that do not cover costs. Cash-constrained governments generally have not explicitly made up the difference. As a result, electrification rates remain extremely low in many developing countries. In such situation, in the era of power sector reform, it seems difficult to attract private distcos to do the job of rural electrification as per the sector's demand.

Access to reliable electricity supply is essential for economic development to take place in the countryside. Further a reliable supply of electricity will have positive impacts on the quality of life of the rural population. For example, children can study at night, people can see the outside world on television and electrical machines can be used to start home businesses. In addition to improving living standards in rural communities, access to electric power brings economic gains through productivity increases in the agriculture sector and among township and village enterprises. Because of these factors the Governments are compelled now to place greater priority on improving the rural electricity supply and coverage.

In the present socio economic context rural electrification co-operatives present a viable public sector approach. In Bangladesh the appalling financial and technical failures of the public power utilities (in 1980) led to the government-supported programs for rural electrification co-operatives based on the US model. Their results are very satisfactory.

Assuming that there shall be sufficient generation and transmission capacity, then rural electrification via the grid is one of the most sought technical options for improving delivery of a range of rural energy services. The technological challenges are to reduce the capital cost of regional and local distribution, metering and billing.

An appropriate institutional structure for rural electricity supply must be designed at the central, provincial, municipal, and village levels. The roles, responsibilities, delegation of authority, reporting levels, and relationship among these entities need to be clarified.

5.2 Rural Electric Co-operative Board (RECB):

In order to oversee and promote the formation of Rural Electric Co-operatives (RECs), plan and undertake rural distribution facilities, prepare operating/functioning rules, compare and evaluate the running of such co-operatives, there shall be a Rural Electric Co-operative Board (RECB) at the center. The board shall be responsible for designing rural electrification system under area coverage for selected geographical areas and all the works from field survey to implementation of the project and handing it over to the respective RECs.

The RECB shall be empowered to receive grants and raise loans from the government and other financial institutions for creating funds for the purpose of carrying out its business and to advance some funds for RECs with such lending terms and conditions as it finds suitable.

It is important to keep in mind that, after a long term, the rural electrification sector can bear the costs of supply once gaining the economic growth and other forms of development in the society. Rural electrification projects can be quite small. In selecting projects, well-defined criteria are important to ensure that funds are allocated efficiently and the program is financially sustainable. Delegating responsibility for evaluating and selecting schemes to the lowest practicable administrative level (as in Chile and Panama) helps to ensure that the projects selected are those most likely to be financially viable. And combining demand-based project selection with community responsibility for a substantial share of project costs (by using tariffs that are not too heavily subsidized, as in the Philippines, or by encouraging the community to bear some of the investment costs, as in Chile) helps to ensure that projects achieve output targets. There is a strong voice that subsidies should be directed toward access to electricity rather than consumption.

The board shall co-ordinate with RECs and handover some low-level expansion works, which do not require extensive technical expertise. The construction of major distribution lines and installation of transformers etc. shall be under taken by the board and after completion handover to the RECs. Then after the RECB shall be acting as a regulator for RECs.

The RECB shall prepare and enforce performance target agreement for improving the operational and management activities of RECs. The board shall publish statements/bulletins periodically depicting the various technical and financial status and achievements of RECs in the country.

Well-planned electrical distribution system, transparency, accountability in management and above all co-operative spirit shall be the guiding factors for RECB.

Co-operative Principle:

Co-operative Principle as defined by National Rural Electric Co-operative Association (NRECA) of U.S.A [8]:

Cooperative businesses are special because they are owned by the consumers they serve and because they are guided by a set of seven principles that reflect the best interests of those consumers.

All cooperative businesses adhere to these seven guiding principles:

1. **Voluntary and Open Membership** — Cooperatives are voluntary organizations, open to all persons able to use their services and willing to accept the responsibilities of membership, without gender, social, racial, political, or religious discrimination.
2. **Democratic Member Control:** Cooperatives are democratic organizations controlled by their members, who actively participate in setting policies and making decisions. The elected representatives are accountable to the membership. In primary cooperatives, members have equal voting rights (one member, one vote) and cooperatives at other levels are organized in a democratic manner.
3. **Members' Economic Participation**: Members contribute equitably to, and democratically control, the capital of their cooperative. At least part of that capital is usually the common property of the cooperative. Members usually receive limited compensation, if any, on capital subscribed as a condition of membership. Members allocate surpluses for any or all of the following purposes: developing the cooperative, possibly by setting up reserves, part of which at least would be indivisible; benefiting members in proportion to their transactions with the cooperative; and supporting other activities approved by the membership.
4. **Autonomy and Independence:** Cooperatives are autonomous, self-help organizations controlled by their members. If they enter into agreements with other organizations, including governments, or raise capital from external sources, they do so on terms that ensure democratic control by their members and maintain their cooperative autonomy.
5. **Education, Training, and Information** — Cooperatives provide education and training for their members, elected representatives, managers, and employees so they can contribute effectively to the development of their cooperatives. They

inform the general public, particularly young people and opinion leaders, about the nature and benefits of cooperation.

6. **Cooperation Among Cooperatives** — Cooperatives serve their members most effectively and strengthen the cooperative movement by working together through local, national, regional, and international structures.
7. **Concern for Community** — While focusing on member needs, cooperatives work for the sustainable development of their communities through policies accepted by their members.

5.4 The rights of electric co-operative:

As defined by National Rural Electric Co-operative Association (NRECA) of U.S.A:

Electric cooperative utilities are unique in that they are owned and controlled by the consumers they serve. In an evolving restructuring of the entire electric industry, electric cooperatives are vigorously pursuing policies that will protect the individual and economic interests of all consumers; included among these interests are:

1. **The right to have access to reliable, affordable and safe electric power.** The availability of reliable, affordable and safe electric power is a necessity for life issue, as well as an important factor that drives the country's economic engine. Consumers have a right to expect reliable, affordable, and safe electric power. Consumers have a right to expect uniform standards of electric power across the country as they travel or move. Each sector of the electric utility industry is different: each is structured differently, financed differently and, aside from the provision of electric service, organized for different purposes. All electric utilities receive federal assistance and the form of federal assistance is different for each sector. In an era of competition, consumers should expect to have many choices. However, all energy providers should have the obligation to provide reliable, affordable and safe electric power. The obligation of lawmakers is to recognize the differences among electric utilities and to treat them differently in legislation.
2. **The right to join together to establish and operate a consumer-owned not-for-profit electric utility.**

Current consumer protection depends on government regulation, local service territories, and voluntary cooperation among thousands of utility systems with local service obligations. If that system is to be replaced with competition, where "big dogs eat first," where utility systems are allowed to become huge combines remote from local consumers, and where energy providers are free to choose the customer class that provides them the most profit, consumers must have a way to protect themselves. All electric consumers must have the right to join together to establish and operate a consumer-owned electric system to provide themselves with electricity according to their own needs.

3. **The right of consumer-owned not-for-profit systems to be treated fairly and recognized as a unique form of business.**

   Electric cooperatives (co-ops) are independently owned business enterprises incorporated under the laws of the state in which they operate. Electric cooperatives are owned and controlled by the consumers they serve. The co-op difference resides in consumer ownership and control. Thus, for co-ops to be treated fairly by government regulation, they must be recognized as a unique form of business, different from investor-owned or community-owned systems. As recognized by the federal courts, since the consumer owns the cooperative, there is no motive for the cooperative to mislead, cheat, overcharge, or act in any way that is not in the consumer-owners' interests.

4. **The right to elect representatives to manage their consumer-owned form of business to best meet their needs.**

   Electric cooperative consumers (members) participate in the operation of the co-op by electing a board of directors from among its co-op consumers to establish the co-op's basic policies, goals and strategies, as well as to determine the rates and types of service(s) they wish to receive. In a competitive environment, consumer-owned and controlled cooperatives will be a more important discipline in the marketplace and a more important force for innovation as long as local ownership, local control and local autonomy are not abridged through unnecessary government regulation.

5. **The individual right to privacy that assures information about consumers will not be released without their prior express consent.**

Historically, consumer-owned cooperatives have advocated levels of information disclosure beyond industry standards but necessary for judging the performance of utility systems. Recently, however, discussions on energy policy have included the idea that utility systems should be required to collect and divulge extraordinary consumer specific information. Consumers should have the right to determine how information collected about them is used. Consumer-owned cooperatives should not be required to collect or to divulge consumer specific information.

6. **The right to determine the scope of energy services to be furnished through their consumer-owned not-for-profit utilities.**

   In a competitive environment, consumer-owned cooperatives, with their local ownership, local control and local autonomy provide a fast, efficient and flexible way for consumers to address their needs.

7. **The right to use consumer-owned not-for-profit utilities to provide additional services that meet the needs of their consumers and communities.**

   All electric consumers must have the right to join together to establish and operate a consumer-owned electric system, if they so choose. In addition, consumers must retain the right to use their cooperative as a means to meet their needs and expectations over time.

8. **The right to work in cooperation with other consumer-owned entities with common goals.**

   Consumer-owned cooperatives should be able to work together to provide a countervailing balance of power in the marketplace to the huge investor-owned combines that are likely to result from deregulation. Consumer-owned cooperatives should be able to work together to provide an open window into the operation of a competitive electric market for all consumers. Consumer-owned, not-for-profit cooperatives should be able to work together to provide a "yardstick" by which all consumers can measure the performance of the market and market participants.

5.5 Rural Electric Co-operative (REC):

In fact, it is a socialistic approach to make people responsible for local management of electric energy distribution by the process of "participatory management." The co-operative concept in energy management may also be called democracy partnership comprising of diverse civil societies scattered throughout the villages of the country. Unlike other co-operatives, electric co-operatives are not for profit-driven basically. They exist primarily to provide service to their consumers. In fact, it is not merely a users' organization, but it is a way of life in which economic activity attains momentum by self-managing and distributing the electrical energy for their own benefits.

It is also a concept of competitive marketplace particularly in the distribution sector of electricity. It should operate on sound business policies and practices although it is basically a not-for-profit organization as already mentioned above. The co-operative model deserves the capability of self-motivation and the system of reward and punishment will automatically be set up to come into effect since all its consumers are the genuine bearers, and the bearers know where the loop holes are.

Rural electrification should go ahead with the co-operative concepts as practiced by other developing and developed countries like Bangladesh and USA, because:

(a) There are high distribution losses since rural feeders are normally too long with enough voltage drops below the standards, backed by undue political pressure to stretch them farther and farther. Implementation of the rural electrification design is usually guided by the exciting political mathematics rather then by the engineering mathematics.
(b) Direct hooking from the nearby LT lines and other kinds of electricity theft have caused rural system loss to be quite formidable to fight.
(c) Difficulty in periodic vigilance due to remote and uncomfortable location of villages has revealed the necessity of local electric co-operatives.
(d) Revenue collection percentage is very poor in rural sectors.
(e) Ordinary rural people are economically, socially and even politically suppressed and hence they are not involved in the decision-making roles in key processes of social transformation. Electric co-operatives may serve as their homes where all of them are treated as equally rightful members and hence discharge their duties seriously as their own household tasks.
(f) All consumers involved in the co-operative service will develop corruption-free system due to well-coordinated check and balance.

In other words Electric co-operatives are:

- private independent electric utility businesses,
- owned by the consumers they serve,
- incorporated under the laws of the states in which they operate,
- established to provide least-cost electric service,

- Governed by a board of directors elected from the membership, which sets policies and procedures that are implemented by the cooperatives' professional staff.

5.6 Functioning of RECs:

REC being the primary unit as an autonomous local co-operative that is owned and run by the consumers. The REC shall constitute a working committee of 10 to 15 members or so and can have hired staffs (of-course members) for routine operational duties like meter reading, bill collection, account maintenance, maintaining consumer database etc. They should have some staffs technically trained to get remedy of simple troubleshooting. For major repair/troubles, provision should be specified that, the technician from the distco be promptly available (daily allowance can be born by REC).

Each REC shall operate a rural distribution system within its command area. The RECB, which set up to carry forward rural electrification program in a planned manner, shall help RECs to attain self sufficiency in the operation and management of its activities. Generally the business of a REC should run as a no-loss no-profit basis. The RECB, as a regulatory body, shall continuously monitors and assesses the engineering, financial and management aspects of RECs and ensures that standards set by the board are achieved. The RECs shall not directly involve in the implementation phase but takes over the system after construction and remain responsible for its management, operation and maintenance. They shall create awareness about safety and economic use of electricity among the users.

5.7.0 Power Purchase and Energy Price:

The RECs shall have full right as that of a bulk consumer to purchase power from the nearby distcos at the bulk price set by the Electricity Regulatory Commission (ERC) or directly from the wholesale market or having a bilateral contract with gencos depending upon their size and location. It seems appropriate to propose that the Government should provide direct subsidies, if it desires, over the bulk price that RECs are paying for the supplier or to any other category of consumer's tariff within RECs jurisdiction.

The retail tariff for the consumer of RECs maybe as that of the nearby ditcos retail tariff or any other rate approved by the RECB.

5.7.1 Typical Tariff Design for eliminating pilferage and other losses:

Let it be possible that each consumer (or a group, if some cannot afford for meter installation) shall be metered. The bulk energy is metered at the source point. The difference between these two will be the losses on RECs side including distribution transformer losses.

Let T_n = the normal tariff rate for the REC Rs/Kwh

E_b = total bulk energy (Kwh) in the month

E_m = total billed energy (Kwh) in the month

k = a constant depending on transformer loss and distribution line loss = (0.85 to 0.80)

T_a = adjusted tariff Rs/Kwh

When $k E_b >> E_m$ pilferage or incomplete billing present in that month, then in that month an adjusted tariff, T_a shall be enforced to all the consumers, which is given by,

under balance condition $T_a E_m = T_n k E_b$

$$\text{or} \quad T_a = \frac{T_n k E_b}{E_m} \quad \text{Rs/Kwh}$$

This means that energy shall be costlier by an amount ($T_a - T_n$) Rs per unit. When the difference ($k E_b - E_m$) is very low there shall not be any adjusted tariff required. When ($k E_b - E_m$) = 0 , or negative the value of k needs to be readjusted to more close approximation (loss of distribution line and transformer) or measures to be taken to minimize the technical losses.

This tariff adjustment within a REC gives incentive for the consumer/member to control theft and losses and also complete billing. This would help the consumer to track down the defaulters in their neighborhood. In this way the non-technical losses can be minimized if not totally eliminated.

5.8 Relevant Action Plan:

Phase I:

Selling bulk power to registered co-operatives:

TDC/distcos/gencos/ shall sell the bulk power to a registered electric co -operative. The co-operatives issue the membership to its villagers and power is sold to them as per guidelines provided by RECB. In this first phase, co-operatives shall not be allowed to look after the distribution network because they are still raw and not experienced, lacking adequate technical knowledge, trainings or the efficient workmanship. We may even call it a warm-up period, requiring a lot to acquire and observe. However, the seller shall treat REC as a bulk consumer, and all the consumers of that particular area then maintain the commercial relationship with the co-operative only.

The consumer-cum members of REC shall be active to eliminate direct hooking and other types of energy thefts. Consequently, the system loss will be decreased. Still another significant achievement will be the increase in revenue collection.

It could be hoped that new service connections, metering, billing, revenue collection and theft vigilance in the rural areas take place smoothly under the co-operative's management, and the consumers' satisfaction comes out.

Phase II :

Handing over LT tines and distribution system:

The area of jurisdiction, ownership transfer and valuation of the assets etc. need to be clarified and then the LT lines and distribution system can be handed with prescribed formalities. There should be some mechanism through which the rural electric co-operatives, at the time of necessity, are adequately funded by RECB. The Government should allocate the budget directly to reach the co-operatives through RECB. Part of the funds available needs to be spent in the trainings of their employees and these co-operatives, at least initially, shall not be expected to produce the electricity by themselves.

Phase III:

Offering greater autonomy to electric co-operatives:

After taking the ownership, the rural electric co-operatives shall be assigned the following franchises:

(a) Construction of new distribution lines or extension of the existing ones with prior approval from the RECB.
(b) Maintenance of the electric network within their areas.
(c) Purchase power from TDC\pool\distcos\gencos or any other authority delegated by RECB. At the later stage these proposed models may anytime be viewed as independent models and my even be applied without the sequence above, after registering a co-operative with RECB.

5.9 Conclusions:

Access to reliable electricity supply is essential for economic development to take place in the countryside. In many cases, most subsidized rural electrification schemes have been run by high-cost, centralized public utilities charging tariffs that do not cover costs and utility supported rural distribution system suffers from high distribution losses, lower revenue collection, slow expansion, poor maintenance and vigilance. It seems difficult to attract private distcos to do the job of rural electrification as per the sector's demand in the changed scenario.

In the present socio economic context, rural electrification by co-operatives present a viable approach with the intent to accelerate the pace of growth and to manage sustainable rural electrification with active community participation.

To act as an umbrella organisaton, to oversee and promote the formation of Rural Electric Co-operatives (RECs), plan and undertake rural distribution facilities, prepare operating/functioning rules, compare and evaluate the running of such co-operatives, there shall be a Rural Electric Co-operative Board (RECB) at the center. It shall be acting as a regulator once the owner ship, and O&M is taken by the local co-operatives.

The board shall co-ordinate with RECs and handover some low-level expansion works, which do not require extensive technical expertise. The construction of major distribution lines and installation of transformers etc. shall be under taken by the board and after completion handover to the RECs. The board shall register REC and maintain database of rural electrification, publish statements/bulletins periodically depicting the various technical and financial status and achievements of RECs in the country.

REC being the primary unit as an autonomous local co-operative that is owned and run by the consumers. The REC shall constitute a working committee of 10 to 15 members or so and can have hired staffs (of-course members).

Each REC shall operate a rural distribution system within its command area. The RECB, which set up to carry forward rural electrification program in a planned manner, shall help RECs to attain self sufficiency in the operation and management of its activities. The business of a REC, unless the central policy changes, should run as a no-loss no-profit basis.

RECs shall Purchase power from TDC\pool\distcos\gencos, depending upon their size and location. The retail tariff for the consumer of RECs maybe as that of the nearby ditcos retail tariff or any other rate approved by the RECB.

It seems appropriate to propose that the Government should provide direct subsidies, if it desires, over the bulk price that RECs are paying for the seller or to any other category of consumer's tariff within RECs jurisdiction.

As a new incentive design, introduction of a monthly varying adjustment tariff within a REC gives a strong incentive for the consumer/member to control theft and losses and also complete billing. They become aware that there are some defaulters in their own neighborhood and check them. In this way the non-technical losses can be minimized/eliminated.

At the initial stage, phase-wise by implementation steps shall help smooth transition and hand over of rural distribution system to REC.

At the later stage these proposed models may anytime be viewed as independent models and can even be applied without the above phase-wise steps, after registering a co-operative with RECB.

After gaining sufficient experience and confidence, the REC principle can be extended for small-scale generation, rural transmission grid and even other renewable energy technology suitable at the particular places.

Although the conclusions are focused on rural electrification and such, the co-operative-take-over can be implemented for other semi-urban\municipal distribution sector as well; such is practiced in many countries. Such moves could be taken as an alternative to divestiture of distribution sector to private companies.

Even if a country is reluctant for fast track power sector reform, the electric co-operatives can be implemented without much difficulty, environmentally or politically.

As the rural electrification is separated from the mainstream, the existing subsidy/cross subsidy from non-rural consumer to rural consumer gets removed. An appropriate Rural Electrification Tax needs to be designed and enforced for gencos, distcos, and captive generators as well. Such tax shall go directly to a Rural Electrification Fund (REF) and then to RECB or such.

CHAPTER 6.0

DISTRIBUTION SECTOR

6.0 DISTRIBUTION SECTOR:

6.1 Introduction:

Distribution sector is an important sector of any power system and spread to reach the end user (i.e. home to home). This sector is the backbone of revenue realization as well. Further these business deals with consumer services, complaints and quality of power supply parameters. Due to the nature of business and huge investments accrued to it and needed more for expansion, this sector is having several issues and challenges in the context of power sector reform and is a central topic of discussion and analysis too.

The performance of power distribution entities in several developing countries is characterized by considerable inefficiencies, which has resulted in poor quality of service and huge financial losses.

The many of the common problems with the present distribution structure are: lack of commercial orientation, high transmission & distribution (T&D) losses, unmanageable sizes, overstaffing, irrational tariff, insufficient investments, managerial inefficiency and political high handedness.

The investments in transmission and distribution have not matched the growth in generation. Tariff revision required political decision-making (at least in policy), as a result of which sound commercial principles had to be repeatedly sacrificed to meet the compulsions of political populism. The size and monolithic structure of distribution operations of the utilities has resulted in lack of accountability, unmanageable size of distribution system, hiding of areas of weaknesses etc. Employees are having low motivation levels, poor productivity, low skill levels and lack of training for skill up-gradation.

Further, the increasing level of political involvement in the day-to-day operations including postings, transfers, procurement and action against errant employees and offending consumers has also adversely affected the smooth functioning of the sector.

6.2 Rationale for Privatization:

It has been accepted that efficiency gains through privatization of distribution would result in the reduction of financial losses of the state entities and reduced outflow of funds from the government towards subsidies. This may help in reducing the requirement of the state resources to be infused into the sector thus allowing the government to utilize funds in other critical areas such as health and education. As commercial viability is achieved in distribution it would also make private investment in generation and transmission viable and self-sustaining.

Privatization is expected to improve operational efficiency, obtain commercially driven tariff rates from Regulators and relieve the government from the burden of subsidizing the sector.

Privatization of the sector is expected to stimulate direct and / or comparative competition in the distribution business. Further, privatization is expected to bring about a commercial orientation and a cost-conscious approach in the distribution business. The change in the management culture and the commercial orientation would assist in reducing losses at a faster pace.

The benefits gained due to higher efficiencies would help in reducing tariffs to the consumer in long term and in improving the quality of service. Further, the depoliticising of the present distribution set up through privatization would be one of the key factors contributing to efficiency gains in distribution business.

The privatized distribution companies are expected to achieve the financing capability to efficiently serve future expansion plans and also, increase efficiency and productivity in operation and management. They are expected to bring in the much needed management dynamism and innovation into the sector.

6.3 Separation of Rural Electrification:

It seems a usual fact that private investors would be interested in the urban/city areas, as they would be able to predict the risks much better and generate faster impact in terms of reduction in losses and other efficiency improvement targets. The distribution system in the urban areas are likely to be better understood than that in the rural areas in terms of load density, the number of consumers and losses and other financial projections.

The nature of rural supply with higher costs, lack of ability to pay as well as the socio-economic objectives would necessitate subsidization to continue for some time. The isolation of the mainstream operations from rural operations and adopting a co-operative-take-over seems a quite viable approach. It is hereby proposed creating a Rural Electric Co-operative Board (RECB) at the center to over see, presently the grid based, rural power supply and later it may be mandated for other means of rural supply in a co-operative way (distributed generation, renewable, rural grid etc.). This has been already explained in the preceding chapter.

Further privatization of urban areas/cities may not result in tariff shock for the consumers as the consumers in the cities are not highly cross subsidized, the load density is quite high in the cities and hence, the tariff hike would be needed only to cover costs, if required. Also, it can be hoped that the capacity of the consumers to pay as well as the acceptability to change would be higher in non-rural areas.

6.4 Selective Approach:

Instead of acquiring some (four or five as in some Indian states) private distribution companies nationwide or state wide, the following selective way can be followed:

(a) ***Single Distco:*** a single distco shall be considered for municipal and semi-urban like areas. Such area has small number of consumers compared to big city area.

(b) ***Multiple Distcos:*** These shall be considered for big metros\urban\city area. The presence of more than one distco is sought such that the distribution business be manageable in size and retail competition can be enforced in future. Further their performance can be compared as all belong to a similar geographical and socio-economic environment.

(c) ***Public Distcos:*** Even we go for privatization, it does not mean compulsory that all the sector-business need to be sold and handed over to private companies then wait hoping every thing will start shining. Further the private companies do not have a magic feature (or

God gift) in themselves. For many instances there may not be coming up sufficient investors to take-over the distribution business.

Considering the above matters along with the public sentiment in a particular area or country, some of the business sector may remain as a "public distribution company" evolved from the existing utility. It shall face the new challenges of efficiency, revenue sufficiency and competitiveness and made to run on a fully commercial principle.

This shall be also an opportunity (as a last chance) for the utility people to show their capability once a clear-cut responsibility is handed over to them.

Further such move shall help manage the unwilling-staff-take-over by the private distcos along with other liability attached with the employees of the utility.

(d) Distribution Co-operatives: These co-operative shall be different from the Rural Electric Co-operatives (RECs) in the sense that they are allowed to make profit and are fully autonomous in functionality.

They can be suitable for municipality\small townships. This approach shall create local employments and it can be a "sustainable development" approach as well.

6.5 Distribution Wheeling Charge and Retail Competition:

There shall be a declared distribution-wheeling charge for each distcos (private distcos\distribution co-operatives\public distcos) approved by the regulator. This can be enforced even full retail competition is not sought for. Some large customers (3-phase or 11 k.v and above), who can have time-of-use meter as per wholesale market duration, can take power watching the price signal in the market paying the distribution wheeling charge.

This wheeling charge (for a consumer category) shall be based on costs of distribution company for its busine ss on a"pure wires" i.e. all items of revenue requirement of a distco excluding power purchase costs and consumers service costs (billing, collecting etc.). Further it shall be computed taking in to account of the projected units sold and wheeled through distribution wires (of different voltage levels) in the ensuing tariff period.

Keeping in view that a large number of small customers do not have capability of keeping time-of-use meters, and other logistical complexities, Retailers (energy supplier ithout owning the distribution wires) are not supposed to be there at least in initial years.

However it can be proposed that once distcos status becomes financially sound and technically capable, consumers can be allowed to choose other supplier distcos in their zone. The one distcos can supply power to a consumer in other distco's area paying it the wheeling charge. Even Retailers are not imagined; any distcos shall be acting as a virtual retailer for the other. This scheme can be implemented, first, in the area having multiple distcos. At the later stages, License shall be given for Retailers to enter in the distco's area (even in a monopoly distco). The distcos/retailers can combine several services for the consumers to attract (even lower the retail rates if price-cape regulation is present).

6.6 Distribution Pricing and Regulation:

Initially rate of return regulation or performance-based regulation shall be the basis for distcos (all types) regulation as long as they are allowed to cover up initial huge investments. Then after it seems appropriate to propose that price-cap-regulation be applied for the zones having multiple distcos. This shall be an incentive for a sort of retail competition as well.

For a monopoly distcos (single distcos in an area) "rate of return regulation with profit sharing" or "Yardstick Regulation" seems better suitable.

6.7 Service Obligations etc.:

A distribution company shall have the obligation to provide distribution services and connections to its system for any end-user within its franchise area consistent with the distribution code. Any entity engaged therein shall provide open and non-discriminatory access to its distribution system to all users.

Any distribution company shall be entitled to impose and collect distribution-wheeling charges and connection fees from such end-users as approved by the regulator. A distribution company shall have the obligation to supply electricity in the least cost manner to its captive market.

The retail rates charged by distribution company for the supply of electricity in their captive market shall be subject to regulation by the regulator based on the principle of full recovery of prudent and reasonable economic costs incurred, or such other principles that will promote efficiency as may be determined by the regulator.

Distribution company shall prepare and submit to the regulator and other concerned office of the government, their annual distributions developments plans and plans for serving such areas as part of their distribution development plans. Areas, which a franchised distribution company cannot or does not find viable, may be transferred to another distribution company, if any is available, who will provide the service, subject approval by regulator.

Other strict and clear-cut service conditions and complaint handling rules shall be designed and enforced with provision of penalty for the responsible entity (too defined by the regulator) regarding:

- New service connection
- Quality of supply
- Pay back penalty for no light (other than load shedding and contingencies)
- Meter testing
- Fault clearing etc.

6.8 Other Aspects:

Before privatization begins, besides deciding the nature and type of distcos, there is required to do a lot of works regarding asset valuation, loss estimation and subsequent loss reduction sought in the coming years, new investments, efficiency improving indicators, consumer-satisfaction-indices, rehabilitation and strengthening works etc.

Working out a clear picture based on realistic assumptions benefits both investors and the government. Detailed information on technical, commercial, administrative, economic and accounting aspects need to be prepared and documented. The whole process should be guided by a philosophy of transparency, in order to satisfy the needs of public opinion, legislative requirements and expectations of potential investors.

Countries, which have addressed employee concerns better, have had a greater level of success with distribution privatization e.g. Hungary and Argentina. Governments have addressed this challenge in many ways. Some of the mechanisms that have been employed are training programs, partition benefits, service contracts for organizing outsourcing arrangements with former employees, ownership programs including the provision of shares at deep discounts, and the placement of privatization proceeds into a fund providing support for displaced workers.

(a) Asset Valuation: Though getting more than book value of an asset may be the government's basic motto, it seems relevant that *"Business Valuation"*

(also adopted in Delhi Vidyut Board Priv.) method may better suit for valuing the asset belonging with the distribution business.

Business valuation is a mix of art and science. The bottom line is, of course, that a business is worth what a buyer will pay for it. Here the revenue earning potential of the business is derived by means of modeling based on certain assumption about reasonable tariff increase, targeted improvements in efficiency, future sales projection etc. The true value is the perceived value to a buyer who is ready, willing, and able to buy it.

It is not unusual for a buyer to ask for the logic behind an asking price. Having a good answer to that question will also enhance the chances of selling the firm for the desired price.

***(b) Loss estimation* (AT&C Loss):** In most of the present situations the conventional measure of transmission and distribution loss or unaccounted energy (the difference of energy input and energy billed) may not able to develop confidence in the investors. In Orissa Privatization the T&D loss estimated before privatization were found to be far less than what it was realized after distcos took over.

The principle of "aggregated transmission and commercial loss" (AT&C Loss), now adopted in India, can be used for the loss estimation purpose. AT&C loss percentage is the difference of revenue of energy input and revenue realized divided by input revenue.

6.9 Demand Side management (DSM):

DSM refers to actions taken on the customer's side of the meter to change the amount or timing of energy consumption. Utility DSM programs offer a variety of measures that can reduce energy consumption and consumer energy expenses. Electricity DSM strategies have the goal of maximizing end-use efficiency to avoid or postpone the construction of new generating plants.

Demand Side Management (DSM) encompasses actions to affect demand for electricity undertaken by the electricity supply industry. The objective is to manage the timing, magnitude and sharpness of daily and seasonal load curves to provide an economically efficient mechanism for matching supply capacity to load. Numerous studies in China and other countries have found that cost-effective DSM programs can reduce electricity use and peak demand by approximately 20 to 40 percent. It has been in practice in many developed countries even after the reform.

As postulated in the research paper by *Steven Nadel* [15]the advantages of a DSM program are:

1. Reduces customer energy bills.
2. Reduces the need for power plant, transmission, and distribution construction.
3. Stimulates economic development.
4. Creates long-term jobs that benefit the economy.
5. Increases the competitiveness of local enterprises.
6. Can reduce maintenance and equipment replacement costs.
7. Reduces local air pollution.
8. Reduces emissions that contribute to national and international environmental problems such as acid rain and global warming.
9. Enhances national security by easing dependence on foreign energy sources.
10. Can increase the comfort and quality of workspaces, which in turn can increase worker productivity.
11. Can create market transformations with long-term results.

6.10 Conclusions:

All type of Distribution Companies shall be inherited from the Transmission and Distribution Company (TDC), unbundled earlier with generation.

Start of privatization (speaking unbundling) of the distribution sector after isolating the rural supply part from the mainstream distribution business can be a better option. Depending upon the nature, area, size and population, selective approach of distribution privatization shall be adopted. Provision of acquiring a single distco, multiple distcos, public distco and distribution co-operative needs to be analyzed and studied.

Some large customers (3-phase or 11 k.v and above), who can have (afford) time-of-use meter as per wholesale market duration, can take power watching the price signal in the market paying the distribution wheeling charge for the distcos contained. So distribution wheeling needs to be allowed even before going to have an open access. The distribution wheeling charge shall be computed taking in to account of the projected units sold and wheeled through distribution wires (of different voltage levels) in the ensuing tariff period.

It can be proposed that once distco's status becomes financially sound and technically capable, consumers can be allowed to choose other supplier distcos in their zone. The one distcos can supply power to a consumer in other distco's area paying it the wheeling charge.

Keeping in view that a large number of small customers do not have capability of keeping time-of-use meters, and other logistical complexities, Retailers (energy supplier without owning the distribution wires) are not supposed to be there at least in initial years.

For the transition period rate of return regulation or performance-based regulation shall be the basis for distcos (all types) regulation. Then after price-cap-regulation can be applied for the zones having multiple distcos: which shall be an incentive for a sort of retail competition as well. For a monopoly distcos (single distcos in an area) "rate of return regulation with profit sharing" or Yardstick Regulation seems better suitable.

Strict and clear-cut service conditions and complaint handling rules shall be designed and enforced with provision of penalty for the responsible entity (too defined by the regulator)

Even in the changed context, Demand Side Management (DSM) has to be implemented. As new players may be reluctant to implement DSM, the responsibility be given to suitable authority to take DSM measures and publicity.

The whole process should be guided by a philosophy of transparency, in order to satisfy the needs of public opinion, legislative requirements and expectations of potential investors and other stakeholders.

CHAPTER 7.0

MARKET STRUCTURE AND MODELS

7.0 MARKET STRUCTURES AND MODELS

7.1 Introduction:

7.1.1 General:

Depending upon the existing organization of the electric industry, different level of competitive market structure can evolve.

(a) Monopoly Model:

In the vertically integrated model, existing generation and all transmission and distribution continue to be owned and operated by the existing utility. The new generation can be added by independent power producers (IPPs) and sold to existing utilities, which then sell the electricity in the retail market. (This model is called the single buyer model.)

Generation may be subject to competitive bidding and is sold to the single buyer under a long-term contract. In this model customers remain captive and hence there is a significant role for an independent regulatory commission. The role of the regulator is to create competitive conditions for the acquisition of new generation. Other important conditions for this model include clear and enforceable contracts with credit worthy buyers.

Competitive generation in this model continues to rest on the financability of the underlying power sales contracts. If contract enforceability or the creditworthiness of the buyer is in doubt, other forms of credit guarantees will be needed.

This model has been an initial step for most countries that have restructures their power sector. Consequently, this model may be particularly appropriate for countries that are just beginning to consider industry restructuring and have a need to attract additional capital to meet growing electricity needs. It allows for competition to be introduced incrementally into an existing system. It provides new sources of private capital and a wider range of options for the purchasing utility than may otherwise have been the case. Risk can be distributed fairly between utilities and developers under the terms of the contracts.

The greatest weakness of this model is that it fails to provide generating efficiencies in existing generating plants. While almost all countries have taken this first step the experience and results have been mixed. The model hinges on an effective and efficient competitive acquisition process. Many counties have signed long term contracts with IPPs without an effective bidding and evaluation process in place.

Most PPAs or power sales contracts are long-term, fifteen years or more, full output contracts. PPAs have become increasingly complex documents that have grown over the past ten years from twenty pages in length to over two hundred pages.

(b) Full Wholesale Competition Model:

In the fully competitive wholesale model, all generation, new and existing, is competitive and generation receives market prices. The utility becomes a transmission and distribution company (TDC). There should be no affiliation between the utility and generators. The utility in this model continues to be the sole buyer of power and the sole retail seller too.

IPPs finance and construct plants based on the financial strength of an underlying power sales contract. In some cases where the markets are more stable and predictable, IPPs have constructed merchant plants with little or no plant capacity subject to a power sales contract.

The utility is a monopoly and is regulated by an independent regulatory commission. Because the utility is a single buyer and customers remain captive. The regulatory role includes regulation of transmission and distribution (T&D) prices and oversight of the utility's purchasing decisions. A significant regulatory role in this model is to create the institutions and rules needed for an efficient generation market. This model is particularly valuable because of the very powerful incentives it can create for the efficient operation and expansion of the generating sector. It can be very effective in reallocating risks in an efficient and fair fashion. It can also be very effective at raising capital and allowing in country capital to be used for other purposes including the upgrading and expansion of the transmission and distribution systems.

Some of the issues to be addressed, if this model is pursued, include price volatility and market design to give reasonable incentives to add capacity when needed. Also, the transition may provide countries with an opportunity to sell existing plants for prices that exceed their existing book value.

(c) Full Retail Competition Model:

In the fully retail competition, the utility is no longer the single buyer. The utility provides the transmission and in some cases distribution access. It has an obligation to connect, but not an obligation to serve. Customers buy generation services from the supplier of their choice. The role of regulation in this model is the least of all possible models.

The regulator focus will be on establishing market structures and market institutions which can assure the greatest level of competition and the greatest level of choice for customers, including prices, service quality, and consumer protection. There is no economic regulation of the generation sector. Regulation ensures open access, reasonable and competitive conditions and generally protection against monopoly power of buyers and sellers. This model has been implemented in many countries including the UK, Norway, and parts of the US, Australia, and Canada.

There are many alternative approaches to industry restructuring. No one model will fit the needs of all countries. The most important step is to begin with a very clear and articulated set of goals and constraints. All restructuring models share certain common elements. These include independent regulatory oversight of monopoly activities, market structures that are free from market power problems, and clear and enforceable property rights.

7.1.2 Wholesale Electricity Market (WSEM):

The wholesale electricity market (also known as a power pool) has both a supply side and a demand side. The supply side of the wholesale electricity market can compose of independent power producers (IPPs), privatized generators (private gencos), generators still owned by the utility unit (public genco)

The demand side of the wholesale market can compose of distribution companies and large users. The interaction of the supply and demand sides of the wholesale market largely determines wholesale prices for electricity. Additionally, a charge (variable w.r.t transacted unit) is added to all of the market-determined prices to cover transmission charges, payments for ancillary services etc.

The WSEM is open to all generators and consumers wishing to participate. The Market Operator (MO) manages and operates the WSEM with an in-dependent facility that attempts to balance supply and demand with an auction, which roughly operates in the following manner:

In the WSEM every day is broken up into one hour or four hour segments. The system manager forecasts demand for each hour of the segment.

Twenty-four hours in advance, generators submit bids for the various levels of power they are willing to supply at various prices and for various periods, for each segment period of the following day.

The market manager then ranks these bids from least to most expensive. The system manager also calculates the minimum amount of genera-ting capacity needed to meet demand projections.

A merit order dispatch schedule is created whereby the cheapest generation units are selected first and supply is capped when enough generation units are selected into the system to cause generation capacity to be sufficient to supply one unit of energy over and above the forecasted demand.

The wholesale purchase price (WPP) for all suppliers becomes the highest price bid by the last generation facility needed to accommodate the last unit of demand (generally this is practiced). This balancing activity is an attempt to arrive at the electricity generation industry's marginal cost, or the system marginal price (SMP). The price actually paid to generators may include a capacity element, a financial incentive for maintaining the capacity available.

The ultimate authority for physical control of the transmission is assigned to a system operator (SO) charged with responsibility for managing the transmission system. This authority includes invoking supplementary generation and reserves as needed to follow variations in the load and to maintain the stability of the transmission system. The SO's authority is a real-time command and control operations.

The emerging trend is that, instead of compulsory bidding in WSEM, the generators can have the option of entering in to "bilateral contracts" with the customers (distcos\large consumers).

Keeping continuity with the concluding remarks of the previous chapters, the study has been focused to bring out first a Wholesale Electricity Market (WSEM) acting as a single buyer and later leading to a fully open WSEM, once the IPPs role is resolved i.e. fully integrated with the market activities and distribution sector freed up from the Transmission and Distribution Company (TDC) attachment.

Another consideration is how the market can be extended to more participants in the future without a complete change at each stage of developmentBefore going to the detail of WSEM, the options for IPP integrating shall be presented.

7.2 WSEM as a Single Buyer:

At the time of privatization of generating sector, there shall be created maximum number of generating plants (private gencos) each do not exceeding 10% of the total capacity. If all the generating plants cannot be fully privatized at the time, then some can remain as a public company (public gencos) running completely in a commercial principle with inherited liability, if apportioned from the utility.

Now there shall be private gencos, public gencos and IPPs with their own PPAs in the field. The WSEM shall be a-day-head market having four-hourly duration (four hourly duration considered rather than half-hourly or hourly, which seems more complex in operation mechanics, alternatively a detail study cane be done over the daily load curves of the system and assessed the optimum time slot duration)

The Market Operator (MO), at this stage a unit within Transmission and Distribution Company, shall do the demand forecasts for the next 24 hours (short term load forecasting) and make available to all the concerned.

All the generating plants shall bid for the following day. The IPPs if not agreed for bidding in WSEM, may continue with their PPAs and later when distcos come out, they may be encouraged for bilateral contracts.

It is hoped that practice of bidding initially makes gencos learn to live with the new system arrangement and know how to construct their offers in order to achieve their commercial objectives.

It is desired to propose that the monopoly entity, TDC, shall not exist for a long time. It should be in a dynamic transition. Further the unbundling of distribution sector shall start at the earliest and transmission-wheeling charge too finalized at the same time. From the time of creation of distcos, they shall purchase energy from the wholesale spot market or have bilateral contracts with any of the gencos or IPPs.

Transmission wheeling charge and retail rates of TDC and distcos shall be under the regulatory control.

7.3.0 Integrating IPPs with the new Market Systems:

IPPs are companies that build and usually operate generating facilities, but are not usually considered utilities. They provide the large capital resources needed to build or buy these plants and recover their costs from the sale of electricity. Depending on the restructuring model selected the role of IPPs can range from representing a fraction of new generating resources to the ownership and operation of all generation.

Many countries, both developing and developed, have reformed and liberalized their electricity industries by introducing wholesale competition and some even retail competition. In developing countries the principle objective has been to mobilize private investment as efficiently and quickly as possible to meet the rapid growth in electricity demand and to improve both the efficiency and quality of service. One of the common challenges facing is how to deal effectively with pre-existing long term contracts, mainly, power purchase agreements (PPAs) with independent power producers (IPPs), and their consequent effect on the reform, particularly where wholesale markets are being designed and introduced.

If IPPs are not integrated into new markets, the scope of competition will be attenuated, new entry will be deterred; and the country will incur large resource costs when plants are to be dispatched out of the merit order. Eventually the above-market-cost of electricity will be passed on to consumers, nullifying the benefits of competitive markets. So, these issues need to be addressed rather than avoided in the context of power sector reform.

7.3.1 Problems Created By IPP Contracts in a new Market Context:

As per the study done by *Fiona Woolf and Jonathan Halpern* [3]:

IPP contracts in general, and power purchase agreements (PPAs) in particular, are not easy to reconcile with the introduction of competitive wholesale markets and with the achievement of sustained gains in efficiency.

(a) The contract terms of PPAs and the associated finance and security arrangements appear, in some cases (usually with the benefit of hindsight), to be expensive, and cheaper power on more flexible terms may become available through the market at a later date. In other words they may create stranded costs reflecting their above-market pricing.

(b) Because the IPPs are protected from market risk by their long-term PPAs they have little incentive to participate in a market. In some countries, their lack of participation would seriously affect the liquidity and indeed the success of the new market in capturing the benefits of market forces, particularly where the size of the IPP plant is a significant proportion of the total plant connected to the system. It is a basic economic principle that there must be an adequate number of buyers and sellers trading sufficient volumes for a market to work effectively.

(c) Forced contract renegotiation is extremely difficult, because of the legal sanctity and enforceability of the contract terms. The same is true of a non-observance or breach of the IPP contracts by the power purchaser (whether actual or threatened) designed to result in renegotiation. There is an understandable nervousness on the part of governments and host utilities on the one hand (fearing that it would deter further private investment), and IPPs and their investors and lenders (as to the project economics and the other project contract terms which protect their interests) on the other. The process is arduous and lengthy with no certainty as to the outcome.

(d) In the early stages of any new wholesale market, prices and the extent of market risk will be difficult to predict, quantify and mitigate. There will always be an initial period for the market to settle down and market rules will change to reflect operational experience. During this period, IPPs would prefer the certainty of the power purchase agreements.

The impact that the design of the wholesale market will have on the IPP contracts and their potential for integration into the market will depend upon the objectives of the new market and the terms and conditions of the power purchase agreements. The key criteria in market design decisions are transparency, fairness, and predictability.

IPP contacts rarely contain incentives to improve efficiency over time. The power purchaser will only be able to re-sell the power at the prevailing market price. The question then arises as to who should bear the above market costs-- the power purchaser, taxpayers or consumers.

The price of capacity and energy under long-term IPP contracts may prove to be significantly higher than the prices in the wholesale market. If the power purchaser is a distco (having captive end-consumers) the regulator may possibly allow the distributor to pass the purchase costs on to the end-consumers, in which case the above-market-costs will be hidden or blended with the cost of other purchases in the wholesale market. If the contract holder/power purchaser is not able to pass the costs on to consumers in this way (e.g. because the regulator does not allow it or because the large customers have the option of purchasing power from others), the above-market or stranded costs will be apparent. In this case, the purchaser will be able to resell the power only at the prevailing market price, which will hamper the financial performance of the distco or so.

7.3.2 ***Approaches to Integrating IPPs into Electricity Markets:*** Integrating IPPs into new markets created as a result of power sector restructuring holds the promise of benefiting consumers through increased competition, liquidity and hence efficiency. The objective is to do so in a manner, which minimizes above-market costs while protecting the IPP economics during the transition.

Integrating IPPs into wholesale market arrangements will require modification of at least some of the following: market rules, IPP contract terms, identity and powers of the contract holder, contract management arrangements, and mechanisms for funding above-market costs associated with the IPP contracts.

The challenge is to do so in a manner, which incentivizes IPP integration without unduly compromising market efficiency nor system reliability. There are several potential approaches to addressing the difficulties discussed in the prior section. These approaches, as postulated by *Fiona Woolf and Jonathan Halpern* [3], incorporate different combinations of policy measures and can be characterized as follows:

- forced market integration
- forced contract negotiation
- integration by adaptation of market rules
- virtual generation/managed contracts
- voluntary renegotiation
- contract buy out.

Voluntary renegotiation stands a much better chance of succeeding than forced renegotiation and others if there is innovative thinking to find mutually beneficial solutions. The other possible option is to encourage IPPs to enter in to "bilateral contracts" (explained in section 7.6).

Many countries, have or are, facing the problem of IPP contract prices which, may have seemed reasonable when the contracts were executed but today seem too high. Renegotiating these contracts is possible but should be approached from the perspective of meeting the needs of both the purchaser and the seller. The key to renegotiation of these contracts is for both parties to have a clear understanding of each other's goals and constraints. With the goals and constraints clearly expressed, creative solutions can generally be found.

As observed by *Fiona Woolf and Jonathan Halpern* [3]; there are a growing number of examples where IPP merchant power plants are being constructed without long-term contracts.

In this case IPPs who have sufficient confidence in the economic, financial, and accounting operation of spot electricity markets or in the strength of retail competition will finance plants based on expected cash flow from direct sales to retail customers\distcos or sales to a spot market. This development is relatively recent and will probably be limited for substantial time to countries that have particularly clear, well-established, and stable electricity markets and underlying institutional and legal foundations that permit financing of this type.

7.4.0 Open Wholesale Electricity Market:

In this stage the distribution sector will be fully separated from the Transmission and Distribution Company (TDC) leaving it as a Transmission and System Operation entity (TSO). The distcos, large consumers and rural electric co-operatives (RECs) all can have the options of purchasing energy from the spot market or can have bilateral contracts with gencos and\or IPPs.

7.4.1 Pricing:

In recent years the development of pricing rules have been focused to minimize\eliminate the scope for gaming, or in other words to remove any incentivesfor traders to lie about their costs. The price for any trade needs to be set up at the level dictated by general market conditions, without regard to the cost of participating buyer and seller. This prevents traders from gaining a higher (or lower) price by manipulating their cost information.

In the electricity market, the marginal price of extra output (system marginal cost/price, SMC/SMP) is the offer price of highest cost generator, which is currently running. SMC is the economic value of electricity at times when demand can be met with available capacity. Some definitions of SMC include just the incremental costs of generation, while other also includes a share of the start-up and no-load costs. For instantaneous purpose, the SMC may be well represented by the incremental cost of generating an additional unit of energy (MWh) from a generator, which has already started up and is "on-line".

When market price is derived from information about the costs of the marginal plant (i.e. most expensive till now) generating at any time, then there shall be little scope for generators to manipulate the market price. Individual generators cannot increase the market price by raising their own bid prices unless they know that their plant is actually at the margin (i.e. setting SMC) or unless there is insufficient competition.

In such conditions, gencos have an incentive to offer a price, which is equal to their costs for two reasons:

- if they offer a price which is too high they may not be dispatched at times when the spot market price is above their real costs
- if they offer a price which is too low, they may be dispatched at times when the spot market price is below their real costs.

Further a market price based on start-up, no-load and availability cost will reward generators for obeying scheduling instruction, will also cover some portion of their fixed costs.

The important thing is that the system adopted for trade should ensure that the lowest-cost genco produces it, the right amount is transported and that the accounting systems are set up so that the consumers pay for what they use and the producer gets paid for what is sold.

7.4.2 Pricing Methods:

In a competitive electricity market the sellers (and buyers too in some countries) submits bids in the form of price and quantity (MW). After the bids are available to market operator (MO), it settles the market based on predefined criteria and rules.

(a) Pay-as-bid basis (PAB):

Here the bidders get the price that they had actually bid for, in the first place. In such case most gencos may not quote a price equal to their costs, but a price equal to "what the market will bear". When the System Operator (SO) calls for the next genco (with higher cost) to come up, and continues running, it implies that the market is ready to bear the new higher price. Then the question arise whether to allow the pre-running gencos to revise their offer prices in the new demand scenario.

If flexible biddings are allowed then it becomes more complex for the system operator and market operator to handle the situation and even for gencos to revise their offer price as frequently and as fast as the conditions change in the market.

Normally the dispatcher requires generators' offer prices to be constant and valid over several hours or even days to account any time constraints like ramp-rates.

Further in these scheme generating real-time-price signal is also difficult. For e.g. genco A has low bid price and running for certain duration and later as load is increased another genco B of higher price bid comes on line. Now suppose a customer who wants to consume power when the low price genco A is running. It shall be difficult to accommodate such opportunity and also a complex task to publish in advance that during the next half hour or one hour this much will be the wholesale Purchase Price (WPP).

The issue of whether to introduce PAB electricity pricing has also been raised in the Californian wholesale market, and the U.S. federal electricity regulator (FERC) has attempted, and failed, to introduce PAB for "high" bids (above $150/MWh) as a temporary market power mitigation measure (FERC (2000)).

A study, by *Federico, G. and D. Rahman* [4] showed that PAB pricing rule is less allocatively efficient than uniform system marginal pricing (SMP) under the competitive benchmark. They also showed that players with market power may react to PAB in ways, which are inefficient, leading to higher prices, lower output and lower welfare.

(b) System Marginal Pricing (SMP):

This is also known as "sealed-bid uniform price auction". Here the sellers submit a price and the maximum capacity they would be willing to sell at that price. Then the offers are ranked from lowest to highest and lowest priced units are dispatched up to the point were supply equals demand. The uniform price paid for the purchased units is either the price of the "last accepted offer" (LAO) or the price of the "first rejected offer" (FRO); in either case, the price is called the "reigning price".

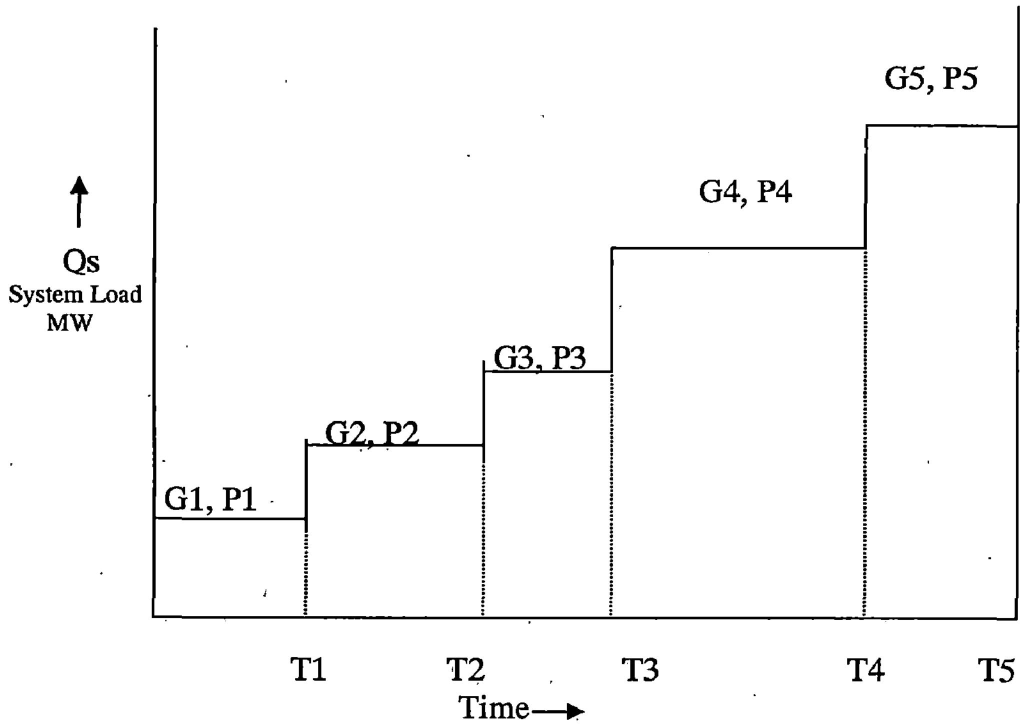
It has been suggested that FRO is in general more efficient than LAO since an LAO auction shares the strategic incentives. Contrarily, power markets in countries like UK and Australia utilises LAO auction.

The gencos are paid more than the marginal cost of the plant so that they have an incentive to run it. In the end, they will not run their plant unless their avoidable costs are covered. Further, they shall not have incentive to build new plants unless all the capital costs are covered.

(b) Successive Pricing (or sequential pricing):

This, as a new method (as far as the student knows), is being proposed for evaluation and further study, if it seems useful. Here the gencos offer sealed bids indicating the maximum capacity and price as in (b) above. After preparing the schedule, the least cost genco is dispatched and it continues to get its own offer price. At the instant the demand exceeds and next higher price genco is called on then both gencos will get the price of the ast genco's offer price and so on. This can be better understood by the fdlowing figure:

(For simplicity straight lines are used instead of curves)



As long as the system load is less than the loading of genco G1, it will get the its own offer price P1.

When the system Load increases and next gencos G2 comes up, then genco G1 will also getting the price P2, offer price of G2. Similarly G2 shall get price as that of G3, i.e. P3 and so on.

When the system load falls back within G2's capacity, then G2 will get its own price P2 whereas G1 will continue to get P2 as long as the load is remaining greater than its declared.

In general, When System Load Qs $<= Q_i$

Payment for i^{th} genco, $C_i = P_i * E_{i, Tj}$

When System Load Qs $> Q_i$

Payment for i^{th} genco, $C_i = P_i * E_{i, Tj} + \sum_{j=i}^{n} [E_{i, Tj+1} - E_{i, Tj}]$

Where,

Q_s = system load at any time (incremental)

Q_i = declared capacity of genco G_i

P_i = bid price of i^{th} genco

$E_{i, Tj}$ = energy meter reading of i^{th} genco at time T_i $(j=i)$

T_i = clock time up to which i^{th} genco is running,

or start time of $(i+1)^{th}$ genco

n = number of gencos in the time slot (i.e. four hour duration)

Also $P_{i+1} > P_i$, total duration of $T_i <=$ four hours.

7.5 Wholesale Purchase Price (WPP) and Wholesale Selling Price (WSP):

To start with the market experience, system marginal pricing (SMP) method shall be adopted. In the proposed wholesale electricity market, the gencos shall have both option of bidding in the WSEM and/ or entering into bilateral contracts (explained in section...) with distcos and/ or large customers. The actual strike price and capacity of bilateral contracts shall be the independent matter of the contracting parties. It is only required to inform the system operator and market operator that such and such is the price and capacity and too the duration of bilateral contract. This is required to settle the imbalance (arising, if any, in real-time operation).

Following steps explain the calculation of WPP and WSP:

(a) The Market Operator (MO) shall prepare the detail load forecast (short-term) for each four-hour of the coming day and make available to all the concerned. A day in advance the gencos shall bid for each four-hour time slot with respective capacity (MW) and price (of-course in Rs./MWh), and information about any bilateral contracts for the day, if any.

(b) A system schedule is produced which is a plan of generation which meets forecast demand at least cost (in terms of bid prices).

(c) For any four-hour, the offer price of the marginal genco (most expensive) operating in the system schedule shall determine the wholesale purchase price (i.e. WPP = SMP)

(d) On the day, the System Operator (SO) issues instruction to gencos as to when and how much to generate and takes over the control of the network.

(e) When SO instructs a genco to deviate from the system schedule output (for the sake of reliability and security of the system) the change in output should be bought or sold by the WSEM. Failure to meet instructions, or to be available as declared the previous day, shall be penalised.

(f) Any genco capacity, offered in the system schedule but not needed shall be paid an "availability-bonus". Likewise any genco, not in the system schedule, if ordered to generate in emergency shall be paid the WPP.

(g) Transmission loss shall be calculated as the difference between the metered input (at point of injection), $\Sigma E_{i/p}$ of gencos and metered output towards the purchaser (including that of bilateral contract) $\Sigma E_{o/p}$, and divided by the total transacted energy in each four-our period. Provision can be made such that genco may share 50% of transmission loss component.

Price due to transmission loss, $P_{tl} = \dfrac{\{\Sigma E_{i/p} - \Sigma E_{o/p}\} * WPP}{\Sigma E_{o/p}}$ Rs./MWh

(h) Wholesale Selling Price (WSP) shall be;

$$WSP = WPP + \left[P_{tl} + \frac{\text{availability bonus (as in (f) above)}}{\Sigma E_{o/p}} + \frac{\text{ancillary service cost}}{\Sigma E_{o/p}}\right]$$

The cost due to congestion management is not taken into account here, as it is supposed to be born by the TSO (chapter 3.0) and a separate account be kept thereof. Also excluding is the transmission wheeling charge in WSP, as such charge may vary (in total) with different customers depending upon their energy withdrawal.

7.6.0 Bilateral Contracts:

In its simplest form, a physical bilateral contract is an agreement between a consumer to buy and a supplier to sell a specified quantity of energy at a specific price. Bilateral market is one in which trades, quantity and price, are determined directly between supplier and the customer. This trading approach has the positive attitude that loads will seek out the cheapest gencos.

Bilateral contracts enable customers to make their best deals for generation supply with whoever in the competitive market is most effective at meeting their needs. Allowing genco to contract directly with customer and/ or distco creates competition on both sides of the transaction. Gencos compete among themselves to supply this demand.

This gives customers and their representatives a full range of choice among generators. Gencos may charge any price the market will bear and may choose to compete not only by price but also by contract duration, payment terms, type of generation and type of electric service. Thus, bilateral contracts will provide a wide range of choices to meet various customer needs.

In any bilateral contract, injection and withdrawal point of transaction are to be specified and also the exact quantity. These data must be submitted in advance of scheduling and dispatches.

In wholesale spot market the prices are highly volatile in nature and this may present uncertainty to the participants and they can agree to hedge the price at certain agreed level designing the bilateral contracts accordingly. Hedging is the process of reducing risk and uncertainty of future price movements. This can be done by Forward Contract, Options Contract or Contract for Differences (CfDs) etc.

7.6.1 Forward Contract:

A forward contract is an agreement for the delivery of a commodity in the future, generally for a term, which may be from a month to years long, at prices fixed at the inception of the agreement. Forwards do not trade on exchanges (like futures contract) and therefore offer more flexibility to contracting parties. A forward contract obliges each party to buy or sell a commodity at an agreed upon future date at an agreed upon strike price. No cash is paid initially and the contract price is paid only at the time of delivery, when the asset is received.

It will be preferred that the contract holder of forward contract (FC) and seller should match their generation and consumption as closely as possible i.e. their load profiles and generation profiles with respect to real-time should match closely. At the end of the time slot (1/2-hour, 1-hour or 4-hour) the imbalances may arise.

If the customer's withdrawal is more than the contracted quantity (energy) for that period, he should pay the excess energy at spot price (WSP) to WSEM. If it is within the contracted limit, then he shall pay the contracted price to the seller via WSEM.

It can be designed the wholesale electricity market rules such that the genco, offering forward contract, if injects more energy than the actual contract in the time slot then it may get the spot price, WPP or the contracted price whichever is smaller.

The combining effect of above (a) and (b) will have the incentive for both the genco and contract holder to remain in synchronism with each other for all the time of contract duration. This necessitates the allowance of self-dispatch also.

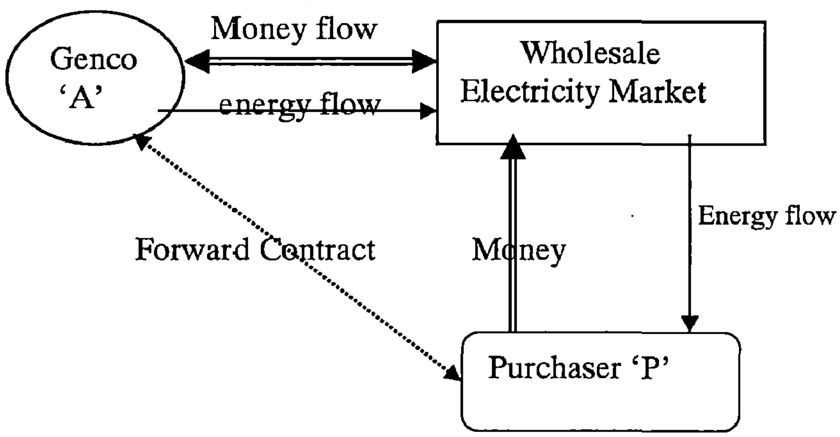
Technically theses can be met but there can be distortion in the spot market price (WPP) and also interest of other players in the wholesale market. For e.g suppose a genco 'A' has a forward contract of 50 MW with a purchaser 'P'. Next suppose in a particular time period the demand of B is just 20 MW. Let's see what happens if at the same time the genco raised its generation to 40 MW or so, intentionally (for the sake of other players) or non-intentionally (by some error from purchaser side). Such situation will alter the generation pattern operation in the WSEM gencos and this leads to distortion in the market conditions.

The possible solution may be:

1. To make System Operator to monitor both the genco 'A' and purchaser 'B' and not to allow self dispatch. This shall be a cumbersome process for SO as the number of forward contract increases and it becomes a complex task to monitor the loading of both the genco and purchaser.

2. Make all the genco to bid compulsorily in WSEM whether they have bilateral contracts or not. The system with such bilateral forward contracts will then be operated in a integrated manner by the SO and settlement of imbalances by the market Operator (MO).

A typical design basis of a forward contract, suggested, is as explained below:



If purchaser ' P' withdraws more energy than the contracted,

'P' pays @ of WSP for excess unit.

If purchaser ' P' withdraws energy within, contracted limit,

'P' pays @ of contract-price for the consumed unit.

If genco 'A' injects more energy than the contracted,

It gets @ of contract-price for the contracted amount,

and @ of WSP for excess unit.

If genco 'A' injects less energy than the contracted, or not at all, and at the same time purchaser ' P' withdraws energy within contracted limit, the deficit, if any, shall be bom by the genco at the spot price (WSP).

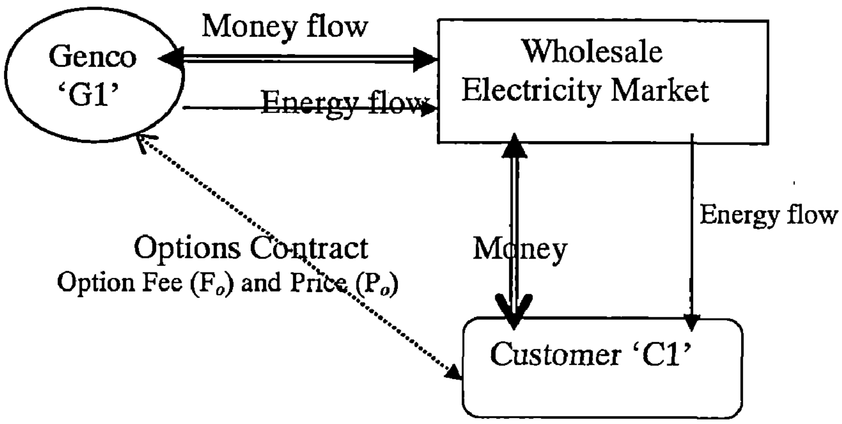
7.6.2 Options Contract:

Option Contract allows the holder to decide whether or not the commodity should be delivered at a later date after paying an option fee. Unlike forward contract, an option contract does not oblige the holder to buy the asset at the strike price, which is agreed initially.

In electricity markets, an option contracts typically include a specified charge (sometimes referred to as the capacity or demand charge) to provide for recovery of the cost of the plant (or, in some cases, recovery of the market-based value of the plant) and related financing. An option contract will also include an energy charge, strike price, to recover, among other things, the variable cost of producing power (the energy charge). Option contracts that contain a specified capacity charge that is based on recovering the cost of the plant and an energy charge are often referred to as capacity contracts too.

An option contract involves an initial premium payment (known as option fee) for the time value of the option, the purchase price of that is payable only if the option is exercised and electricity is delivered.

A typical design basis of an option contract, suggested, is as explained:



If WSP >= P_o, C1 pays only @ of P_o for the energy consumed

to G1 via WSEM (option called).

If WSP < P_o, C1pays only @ of WSP for the energy consumed to WSEM

The Customer will have incentive to withdraw at the time when WSP < P_o, and even if it withdraws when the spot price is high, it needs to pay only the strike price agreed with genco at the time of option contract paying the option fee. The genco has got freedom to bid in the wholesale market and take advantage. Hence both will be in a win-win situation.

7.6.3 Contract for Differences (CfDs):

The contract for differences [CfD] allows for bilateral contracts to be negotiated between generators and consumers. It is a bilateral contract with a specified strike price in which, each party ensures the other against discrepancies between the strike price and spot price. The strike price, for instance, may be set at an average of expected daily pool prices.

A CfD is normally structured as a call and put option with a specified exercise price, and the difference with the spot price is paid to either party. Normally a call option is called when the spot price is higher than the contract price and the seller must transfer the difference to the buyer (may be to the market, WSEM). A CfD structured, as a put option, would be also called when the spot price was less than the contract price and the buyer would transfer the difference to the seller.

A "two-way" CfD with combined call and put options can be exercised under all condition and is equivalent to a Forward Contract with more flexibility.

7.6.4 Futures Contract:

A futures contract is a standardized contract, traded on an exchange, and subject to regulation. Futures' contracts cannot be negotiated, except for price, which once set, is locked in for the month covered by the contract. The fact that the contracts are standard is what makes them liquid, and therefore valuable for power marketing purposes.

Futures are similar to forwards that specify a price and a future delivery. The most important difference is that whereas a forward contract is bilaterally negotiated between two parties who are transacting directly with one another, a futures contract is traded on an organised exchange.

Futures exchanges effectively act as the middlemen between buyer and seller on every trade. This means that one party can buy a futures contract from the exchange, and another party can simultaneously sell the contract to the exchange. So that they appeal to a wide range of buyers and increase market liquidity, futures contracts have to be standardised as to their terms and conditions. Forwards on the other hand, are individually structured by the negotiating counter parties.

The profit on the contract, which accrues to the holder of the contract, is the difference between the price paid for the contract and the market value of the asset at the maturity date.

Futures contract are the out come of a highly developed electricity market.

7.7 Market Operator (MO) and its Role:

The generators and the customers are typically well distributed geographically and Kirchhoff's laws determine the routes taken by the power on the transmission system. It is immaterial to say and find whose power is flowing to whom. At all conditions of real time balance there shall be a larger or smaller mismatch between contract amounts and the production of individual generators or the consumption of individual customers. It is essential that there should be set up a mechanism to deal with these mismatches or imbalances.

The imbalances must be settled as if they were instantaneous spot transactions. Each genco who is deficient in meeting the contracted generation sales should be able to make up with a purchase from some other gencos. Each genco who has surplus generation should be able to sell its surplus to someone else in the market. Each transaction should get its cash flow settled regularly.

To have all this task done there comes an organization named "Market Operator (MO)" acting in accordance with some joint agreement among the players and rules set by laws or regulators.

The MO itself does not buy or sell electricity; it runs the wholesale energy market (WSEM). Based on bids and offers from consumers and suppliers, the MO determines the amount of energy to be consumed or supplied by each company, and the price for that energy. It also authorizes market participants, publishes market information, produces invoices and performs financial settlement transactions for the market.

The MO also administers a set of rules (the Market Rules) that govern the operation of the wholesale electricity market. The MO monitors market activity to ensure compliance with these rules, and perform surveillance of market activity to ensure effective market competition. Most of the other works and roles of market operator are covered in sections and subsections of previous chapters too.

The MO and all market participants are jointly responsible for ensuring the reliability of the power system. It also has a responsibility to forecast the electricity demand and to assess whether existing and proposed generation facilities are adequate to meet the system's needs.

In continuity with the proposed reform structure in the preceding chapters, the Market Operator can be embedded as a unit within the Transmission and distribution Company (TDC), as TDC shall be acting as a single buyer for some time. In later stages, if the situation warrants, the market operator can exist as a separate independent entity. The Transmission and System Operator TSO and MO are in combined existence in some countries and functioning well.

7.8 Ancillary Services:

The term 'ancillary services' generally refers to power system services other than the provision of energy. Specifically ancillary services are those functions performed by the equipment and people that generate, control, transmit and distribute electricity to support the basic task of transmission. For e.g. automatic generation control (AGC) for load following on a second-by-second basis, spinning reserve capacity that can be ramped in 10 or 30 minutes, and replacement reserve capacity that can be called with 1 hour notice to replace spinning reserve that has been activated. Reserves are sometimes differentiated between incremental and decremental reserves. Common acronyms are AGC, TMSR (spin that can ramp in 10 minutes) and TNSR (non-spinning reserve that can ramp in 30 minutes or 1 hour). Ancillary services are required for reliable operation of the power grid.

A standard definition of these services is not globally accepted. The North American Reliability Council (NERC) together with Electric Power Research Institute (EPRI) has identified 12 ancillary services. They are:

1. ***Regulation:*** The use of generation or load to maintain minute-to-minute generation/ load balance within control area.
2. ***Load Following:*** This service also refers to instant-to-instant balance between generation and load.
3. ***Energy Imbalance:*** The use of generation to meet the hour-to-hour and daily variations in load.
4. ***Operating Reserve- Spinning:*** The provision of unloaded generating capacity that is synchronized to the grid and can immediately respond to correct for generation/ load imbalances, caused by generation and/ or transmission outages and that is fully available within several minutes.
5. ***Operating Reserve- Supplemental:*** The provision of generating capacity and curtail able load to correct for generation/ load imbalances, caused by generation and/ or transmission outages, and that is fully available within several minutes. However, unlike spinning reserves, supplemental reserve is not required to respond immediately.
6. ***Backup Supply***
7. ***System Control:*** The control area operator functions that schedule generation and transactions and control generation in real time to maintain generation/ load balance.
8. ***Dynamic Scheduling***
9. ***Reactive Power and Voltage Control from Generator Sources:*** The Injection or absorption of reactive power from generators or capacitors to maintain system voltages within required ranges.
10. ***Real Power Transmission Losses***
11. ***Network stability Services from Generation Sources;*** maintenance and use of special equipment (PSS and dynamic braking resistances) to maintain a secure transmission system.

12. ***System Black Start Capability:*** the ability of a generating unit to proceed from a shutdown condition to an operating condition without assistance from the grid and then to energize the grid to help other units start after a blackout occurs

In the new market environment, the Transmission and System Operator (TSO) has acquired a central coordination role and carries out the important responsibility of providing for system reliability and security. It manages system operations like scheduling and operating the transmission related services. The TSO also has to ensure a required degree of quality and safety, provide corrective measures under contingent conditions.

In this respect, certain services, such as scheduling and dispatch, frequency regulation, voltage controls generating reserves, etc. are required by the power system, apart from basic energy and power delivery services. Hereby System Operator is having the responsibility of handling the ancillary services on behalf of the market participants.

Before entering in to new market environment such services are simply and naturally bundled in to the main activities of generation and transmission and the costs associated with energy generation and ancillary services provision are internalized. Some PPAs and some Grid Codes or Technical Rules oblige generators to provide certain services as a matter of course, free of charge. In the new market setup there may arise debate about how these services should be procured and main considerations in procuring are the costs of providing ancillary services and the value of the services to the system.

Competitive markets for ancillary services are not widespread and this is an active research topic. Many of these services are obtained by long-term contracts in some countries. Even in UK, where the electricity sector is highly commercialsed and competitive, payments for ancillary services originally took the form of lump-sum payments for willingness to perform certain duties.

Some generator-based ancillary service can be mandated; all gencos could be required to provide frequency control as a precondition of connecting to the network (unless the system operator wishes to encourage some gencos to provide more than others). In some electricity markets (as in Spain) both the mandatory and market-based approaches are combined for ancillary service requirements.

7.9 Conclusions:

The gencos shall bid into a day ahead WSEM. It is suggested that four-hour duration shall be the time slot for initial years (or it could be assessed after a detail study of daily load curves and whence 1-hourly or so can be decided).

It is hoped that practice of bidding initially makes gencos learn to live with the new system arrangement and know how to construct their offers in order to achieve their commercial objectives.

The IPPs shall be integrated with the WSEM operation giving them the option of i) voluntary negotiation and entering into bidding and / or go for bilateral contracts with the demanders (distcos\large customers\RECs) ii) or remain where is as is basis with their own PPAs (may be watching the new market behavior) and selling power to the Transmission and Distribution Company (TDC).

The wholesale purchase price (WPP) shall be based on System Marginal Pricing. Alternatively Successive Pricing can be the next option.

Bilateral Contracts shall be allowed from the very beginning of WSEM. By use of which, distcos\customers\RECs can establish various service contracts with any supplier in order to obtain the lowest rate and most desirable service.

It is hoped that suggested design of 'forward contract' (section 7.6.1) and Option Contract (section 7.6.2) evolves as an efficient financial mechanism to hedge the various risk foresighted by the players.

It seems optimal approach that the Market Operator (MO) shall remain as a unit within the TDC. Later, when independent market environment develops, the MO can be separated from the Transmission and System Operator (TSO) and become an IMO.

Regarding the fulfillment of ancillary services, initially, the PPAs (with IPPs) shall be utilized and lump-sump payment type procurement can be adopted (as new entrants will be less willing to provide ancillary service unless they receive some explicit remuneration. Later ancillary service market may come in existence.

We can be confident that the IPPs, after evaluating the scope of ancillary service market (which is nearly free with PPAs), Bilateral Contract facilities and other market opportunities, shall terminate with their PPAs, if not negotiate, and enter into the competitive market.

CHAPTER 8.0

CONCLUSION

8.0 Conclusion:

8.1 Concluding Points:

Following points are to be concluded from the entire study:

(1) Initially the wholesale electricity market (WSEM) as a single buyer should be formed at the time of unbundling generation.

(2) If all the generating plants cannot be fully privatized at the time, then some can remain as a public company running completely in a commercial principle with inherited liability, if apportioned from the utility.

The gencos shall bid into a day ahead WSEM. It is suggested that four-hour duration shall be the time slot for initial years (or it could be assessed after a detail study of daily load curves and whence 1-hourly or so can be decided).

It is hoped that practice of bidding initially makes gencos learn to live with the new system arrangement and know how to construct their offers in order to achieve their commercial objectives.

It seems relevant to propose that some legal provisions, at appropriate level, be made such that *"power sector emergency"* can be enforced and the government intervention in the market be sought for a short time to overcome the type of crisis as that of California Power Crisis or any other National Contingency that may arise. Even in such emergency, it should be ensured that, there should not be any adverse financial effects for the market participants due to the state intervention for a short time.

(3) The IPPs shall be integrated with the WSEM operation giving them the option of i) voluntary negotiation and entering into bidding and / or go for bilateral contracts with the demanders (distcos\large customers\RECs) ii) or remain where is as is basis with their own PPAs (may be watching the new market behavior) and selling power to the Transmission and Distribution Company (TDC).

(4) It is desired to propose that the monopoly entity, TDC, shall not exist for a long time. It should be in a dynamic transition. Further the unbundling of distribution sector shall start at the earliest and transmission-wheeling charge too finalized at the same time. From the time of creation of distcos, they shall purchase energy from the wholesale spot market or have bilateral contracts with any of the gencos or IPPs.

Transmission wheeling charge and retail rates of TDC and distcos shall be under the regulatory control.

(5) In the present socio economic context, rural electrification by co-operatives present a viable approach with the intent to accelerate the pace of growth and to manage sustainable rural electrification with active community participation.

A Rural Electric Co-operative Board (RECB) at the center shall be acting as a regulator once the owner ship, and O&M is taken by the local co-operatives.

The Government should provide direct subsidies, if it desires, over the bulk price that RECs are paying for the seller or to any other category of consumer's tariff within RECs jurisdiction.

The proposed "monthly varying adjustment tariff" within a REC gives a strong incentive for the consumer/member to control theft and losses and also complete billing.

(6) Start of privatization (strictly speaking unbundling) of the distribution sector after isolating the rural supply part from the mainstream distribution business can be a better option.

Provision of acquiring a single distco, multiple distcos, public distco and distribution co-operative needs to be analyzed and studied.

It desirable that once the distco's status becomes financially sound and technically capable, consumers can be allowed to choose other supplier distcos in their zone. The one distcos can supply power to a consumer in other distco's area paying it the wheeling charge

(7) The wholesale purchase price (WPP) shall be based on System Marginal Pricing. Alternatively Successive Pricing can be the next option.

(8) Bilateral Contracts shall be allowed from the very beginning of WSEM. By use of which, distcos\customers\RECs can establish various service contracts with any supplier in order to obtain the lowest rate and most desirable service.

It is hoped that suggested design basis of 'forward contract' (section 7.6.1) and Option Contract (section 7.6.2) evolves as an efficient financial mechanism to hedge the various risk foresighted by the players.

(9) It seems optimal approach that the Market Operator (MO) shall remain as a unit within the TDC. Later, when independent market environment develops, the MO can be separated from the Transmission and System Operator (TSO) and become an IMO.

(10) Regarding the fulfillment of ancillary services, initially, the PPAs (with IPPs) shall be utilized and lump-sump payment type procurement can be adopted (as new entrants will be less willing to provide ancillary service unless they receive some explicit remuneration. Later ancillary service market may come in existence.

(11) When the power sector reform nears completion, the distribution sector will be fully separated from the Transmission and Distribution Company (TDC) leaving it as a Transmission and System Operation entity (TSO). The distcos, large consumers and rural electric co-operatives (RECs) all can have the options of purchasing energy from the spot market or can have bilateral contracts with gencos and\or IPPs.

(12) We can be confident that the IPPs, after evaluating the scope of ancillary service market (which is nearly free with PPAs), Bilateral Contract facilities and other market opportunities, shall terminate with their PPAs, if not negotiate, and enter into the competitive market.

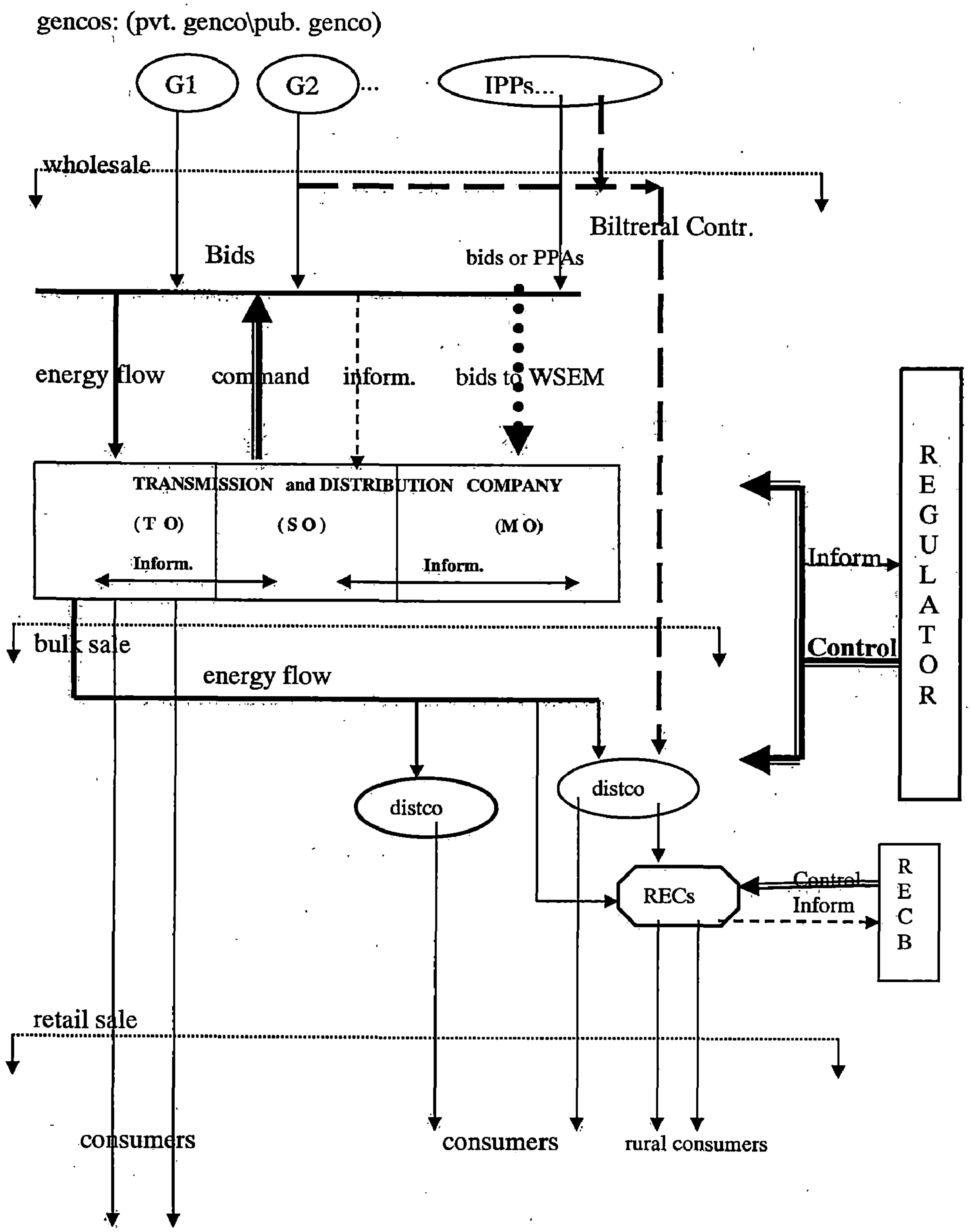
Also we should be aware that worst could be happened i.e. all the government and business efforts failed, the IPPs by any means would like to stick with their own PPAs. In such circumstances, as a solution, they shall be allowed (of-course) to remain with their PPAs with a mandatory provision that they must submit their strict capacity schedule for the next day in advance to the System Operator. This will allow integrated operation and avoidance of any distortion in the wholesale market. The System Operator can then be able to operate the system in such a way that the WSEM participants' activities can be superimposed upon the IPPs generation profile.

(13) Integrating and correlating all the aspects and conclusions, the journey of power sector reform shall have two modes:

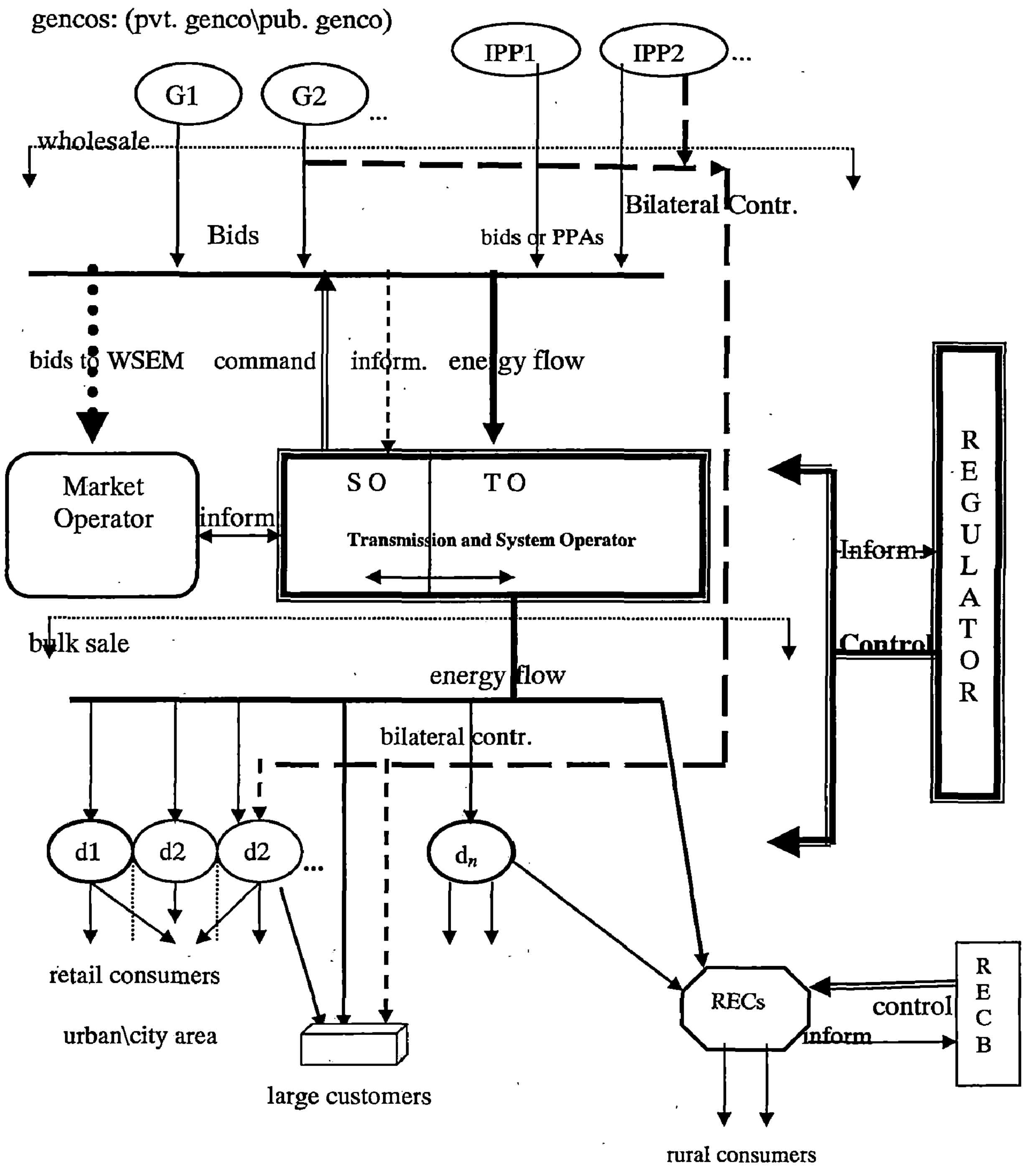
(a) A model in transition with TDC

(b) An advanced model with TSO

The structure and components of these models are self explanatory and depicted in the next pages respectively.



8.1 (a) The Model During Transition with TDC



8.1 (b) Advanced Model with TSO

conclusions contd...

(14) Finally, the power sector reform process is a long and complex process. It should commence with the drafting, in a participative manner, of realistic national objectives and with the laying down of a comprehensive reform plan. Having such in hand, government and policymakers can monitor the implementation of the reform process and modify the regulatory regime as experience is gained and as market changes and new market evolves. The whole process needs to be guided by accountability and transparency.

This will mean that the steps on the way to reform may have to be taken more gradually and the design of the market should, at least initially, be relatively less complex than in some developed countries. The countries such as U.K and Australia were not far out of experimental stage regarding power sector reform and they are continuously changing and improving the market rules (OFGEM in U.K has later introduced New Electricity Trading Arrangement, NETA).

It is hoped that the findings and conclusions brought out may assist the designers of Power Sector Reforms, Policy Makers and Professionals engaged in today's power sector.

Actually the power sector reform brings different expertise into close contact; engineers who like to operate sophisticated power systems, economists who like to think about optimal incentives, and lawyers who like to write rules and agreements. But unless these experts work together in designing sustainable institutions, all of them will fail at their chosen task. Last, not the least, there should be a strong political will of the country to go ahead with the sector reforms with proper accountability and transparency.

8.2 ***Scope for Further Studies:***

- Transmission Planning and Congestion Management in a Competitive Market.
- Ancillary Services Market Development.
- Hydro-Station Scheduling in a Competitive Market.

APPENDIX-1

APPENDIX-1

BRIEF SUMMARY: CASE STUDY OF POWER SECTOR REFORMS IN DELHI INDIA*

The leadership of the new State Government elected in December 1998 was very conscious of the fact that without reforms Delhi Vidyut Board (DVB) would remain a liability, not merely on account of its financial losses but for its image, and the new Government therefore made power sector reforms one of its primary objectives. It brought out a Strategy Paper in February, 99 which provided for the establishment of a Regulatory Commission; unbundling which would start with the establishment of a generating company; disinvestments of distribution, a commitment to protect the interests of staff; and some interim measure to improve DVB's performance. The reform package as initially envisaged was rather different from the final package that evolved over the following three years in response to the requirements of the situation as it developed.

Background to the Reforms:

The Delhi Vidyut Board (DVB) was a State Electricity Board set up in 1997 under the Electricity (Supply) Act, 1948, succeeding the Delhi Electricity Supply Undertaking (DESU), which had existed since 1957 as a wing of the Municipal Corporation of Delhi; it was an integrated utility with generation, transmission and distribution functions serving all of Delhi except the NDMC and MES (Cantonment) areas, to which it supplied power in bulk.

The creation of DVB, replacing DESU, in 1997 proved to be merely a change in the legal status of the organisation and was not followed by any real change in its structure, functioning and work culture: its reputation continued to deteriorate and its

* Excerpts are taken from:
a) "Power Sector Reforms in Delhi: The Experience so far" by Jagdish Sagar available online at http://www.worldbank.org/wbi/investmentclimate/southasiaic03/pdf/readings/ses2.1 /ses2.1_powersectordelhi.pdf
b) "Power Sectors Reforms in Delhi" By Government of Delhi available online at http://delhigovt.nic.in/ or at http://www.unpan1.un.org/intradoc/groups/ public/documents/APCITY/UNPAN010154.pdf/

poor commercial performance the best known thing about DVB perhaps being its high Transmission and Distribution (T&D) losses made it a drain on the public exchequer and incapable of raising the resources necessary to improve its services. There were unprecedented, widespread expressions of public discontent during the difficult summer of 1998.

Delhi's agricultural load is negligible, which gives the distribution business here an undoubted advantage over that in most other States in India; this advantage is, however, offset to a considerable extent by the presence of a large unauthorised and officially un-electrified population. There are currently about 1400 unauthorised residential developments (called "colonies") over and above 600 that have been regularised, and a population of about 3 million living as squatters (in *"jhuggi jhopri basties"* or squatter settlements). There is a similar mismatch between planned and actual land use (i.e. residential areas turned into commercial areas etc.). The effects of this situation were compounded by certain provisions of the Delhi Electricity Control Order (DECO) in force from 1959 to 1999, which restrained the utility from supplying power to unauthorised structures or for unauthorised commercial or industrial use. While this proved ineffective as a means of planning control, it compelled the growing population of those excluded from lawful access to electricity to steal it: in 2001, DVB estimated that about 14% of Delhi's power consumption was going to the un-electrified colonies and *jhuggi basties.*

A Fast-track Reform Process:

Against the above background, one of the first major steps taken by the new Government of the NCT of Delhi was to bring out a Strategy Paper on Power Sector Reforms in February 1999. There followed a unique, innovative yet fast track reform process that ultimately resulted in the unbundling of DVB and privatisation of distribution with effect from 1st July 2002. The Delhi power sector reforms are now being widely acclaimed as marking a breakthrough, and are being widely studied. The methodology adopted in Delhi has also been favorably commented on in the report of the Distribution Reform Policy Committee appointed by the Central Government under the chairmanship of Shri

A.K. Basu, then Secretary (Power) in the Central Government and now Chairman of the Central Electricity Regulatory Commission.

Milestones

Some of the major milestones in these historic power sector reforms process actually were:

February 1999: The Government brought out a Strategy Paper on power. This paper envisaged:

- Setting up of a Regulatory Commission;
- Unbundling of the Delhi Vidyut Board into separate Generation, transmission and distribution companies;
- Disinvestments of distribution;
- Interim measures to improve the performance of DVB;
- Protection of staff interests.

March 1999: The Delhi Electricity Regulatory Commission (DERC) was set up under the Electricity Regulatory Commission's Act, 1998. At this stage the power of tariff fixation, norm setting etc. was conferred on the Commission but not licensing power.

November 99: Consultants engaged (SBI Capital Markets, a subsidiary of the State Bank of India).

December 99: Chairman and single- member of DERC appointed.

April 2000: The Consultants submitted an initial "Inception Report". (This continued to be processed in the Delhi Government Secretariat until January 2001.)

June 2000: GNCTD constituted a Coordination Committee to monitor the progress of the reforms, including representatives of the Ministry of Power, Power Finance Commission and the Consultants. The Committee expedited secretariat processing.

October 2000: The Delhi Electricity Reforms Ordinance was promulgated. The Ordinance

- empowered GNCTD to restructure the power industry;
- gave DERC full powers to regulate the power industry including licensing, restricting the Government's role to policy matters. On the same day a Tripartite

Agreement was signed between GNCTD, DVB and employee representatives ensuring the following to all the present employees of DVB:

- No retrenchment;
- No change in service conditions;
- Service under DVB and under successor entities to be treated as continuous;
- Creation of a fund to be administered by a Trust to be set up by the Government, with Principal Secretary (Power) as chairman and with other Government representatives plus employees, for retirement benefits of existing pensioners and employees.
- Existing welfare schemes like compassionate appointment and medical reimbursement etc. to continue.
- Ad hoc pay increase of Rs.500/- monthly on transfer to the new corporate entities, adjustable against next pay revision.

November 2000: The Delhi Assembly passed the Delhi Electricity Reform Bill, which was sent for Presidential assent.

January 2001: The Cabinet of GNCTD accepted the Consultants' Inception Report with some modifications.

January 2001: An Investors' Conference was organised by GNCTD, DVB and the Power Finance Corporation (PFC). More than 100 attended – major national and international companies, financial institutions, foreign diplomatic representatives and industry associations.

February 2001: Request for Qualification documents were issued, inviting Statements of Qualification by April 16, 2001. The main eligibility requirement was that the bidder should be a company with a net worth of Rs.500 cr. The documents were sold to 31 parties.

March 11, 2001: The Delhi Electricity Reform Act came into force, after receiving Presidential Assent.

May 10, 2001: A Committee was set up to evaluate the SOQs received. It included the representatives of the Ministry of Power, Central Electricity Authority and a senior outside expert, besides officers of GNCTD.

May 2001: After seven prospective bidders submitted their SOQs, the Committee prequalified six: A.E.S., BSES, China Light & Power, CESCON, Reliance and TATA Power.

July 2001: Six 'shell' companies were registered, viz. a Holding Company, a Generating Company, a Transmission Company and three distribution companies. These would become successor entities of DVB on operationalisation of the Transfer Scheme. The consultants submitted their Final Report.

October 2001: The GNCTD Cabinet approved the Consultants' Final Report.

November 2001: Government issued the Transfer Scheme Rules, which gave the Opening Balance Sheets of the new companies and laid down the manner in which the assets and functions of the DVB would be transferred to the new companies.

November 2001: Government issued Policy Directions binding the regulatory commission to the conditions on which distribution companies would be disinvested as a result of the bidding process.

February 2002: DERC fix the opening loss levels and initial BST, which was a pre-requisite for receiving bids.

April 2002: Bids were received. The Cabinet considered the bids unacceptable 'in the present form' and a Core Committee of senior officers was authorized to explore alternatives including negotiations.

May 2002:

- The Cabinet met and approved the report of the Core Committee, which had obtained acceptable bids after protracted negotiations.
- The Share Acquisition Agreement was signed with the successful bidders.

June 2002: The Shareholders' Agreement and other agreements with the bidders were signed. Transfer Scheme was operationalised and the management handover to the successor entities including the three distribution companies under private management become effective on midnight of June 30th 2002.

With the privatization of DVB, the size of the private sector in power distribution in India has roughly doubled. In this context, it was also a relevant consideration throughout the reform process that there were relatively few parties who might be willing to take over the enormous task of distributing power in the national capital, with all its attendant risks. The earlier privatization in Orissa had appeared only a partial success and the companies, which had taken over distribution there, had been suffering losses.

Other features of Delhi power distribution: The heavy losses in Delhi were well known. Some of the other features of power distribution in Delhi include:

- Very high per capita consumption: per capita consumption in Delhi is about 1228 units against the national average of 338 units (1998-99).
- Rapid growth in load and consumption both, Delhi's population and the urbanized area have been expanding rapidly both in a largely unplanned manner.
- Variable requirement: There is a wide gap between the peak and off-peak loads in Delhi. In winter, the load early in the morning is double the load at night, and even in summer there is a wide gap between the peak and off-peak times. Again there is a substantial variation seasonally. The states with agricultural loads ar able to flatten the load and consumption curves throughout the day by supplyin agricultural power in off-peak periods, but in Delhi it becomes necessary to mak costly and difficult arrangements for power supply for the peak period.
- Unauthorised development: In Delhi the advantage of negligible agricultura power is offset by the presence of unauthorised colonies. Electricity was stolen i unauthorised colonies and jhuggies, which we are not formally electrified an metered. It will be a Herculean task to bring the unauthorised areas within th billing net.
- Its T&D losses were perhaps the best-known thing about DVB. These losses hav increased substantially during the previous decade.

Privatisation not corporatisation was the aim

In other states where reforms have been introduced, the policy has been to first creat Government-owned corporations managing distribution and then gradually start th process of privatization. These government corporations run for several years and th experience so far does not indicate that they have been able to function viably. In Delhi the intention was to privatize and not merely to corporatise, and the interim period c Government corporate functioning envisaged in other states was by-passed here. DVI continued to function until midnight of 30th June 2002 and was immediately succeeded by the private companies in Distribution.

Fixing improvement targets

The basic problem of the power sector in India is that the distribution business incurs heavy losses, being unable to issue bills for all that energy supplied (i.e. high T&D losses) and unable to collect payment for many of the bills that are issued (i.e. low collection efficiency). The basic purpose of power sector reforms is to reduce these losses and make this sector self-sustaining. Commercial efficiency is the ultimate consumer interest because it means the consumer will not have to bear the cost of the utility's losses, and this alone will ultimately keep the tariff under control. In Bombay, where the losses are low, there has been no tariff increase for six consecutive years and yet the utilities are profitable. That shows why it is absolutely necessary that any reform package should involve a steady, targeted reduction of T&D loss.

Measurement of commercial efficiency

All State Electricity Boards issue figures of the T&D losses but, with the exception of Delhi where all registered consumers were metered and bills were printed on the metered consumption, these figures lost much of their credibility. The T&D loss figures of State Electricity Boards do not bear scrutiny because much of the billing is on a flat rate basis (i.e. without meters) and can easily be inflated to keep the losses from appearing high. Thus after the reforms in many States, it has been found that the T&D losses were much higher than had been stated earlier. In Orissa this misinformation caused the investors who took over the distribution companies to suffer heavy losses. In Delhi, both the figures were more accurate, but it did happen that after the accounts were finalised they would sometimes be one or two percentage point different from the original figures.

In order to create faith and confidence in the data in Delhi, it was introduced a new concept of Aggregate Technical & Commercial (AT&C) Losses in place of T&D losses. T&D losses are the difference between energy supplied and energy billed; but since this figure may not always be accurate, the criterion adopted in Delhi was the difference between the number of units of energy supplied and the number of units of energy for which payment was actually recovered. This new criterion was called AT&C losses and it has since been adopted (under the term 'effective loss') by the UPERC in its last tariff order for Kanpur, and is now being advocated for all States by the Union Power Ministry.

Fixing the targets

In Delhi at current prices one percentage point of AT&C losses involves about Rs.80 crores per annum. In other words if an investor misses a target of AT&C loss reduction by 1% he stands to lose about Rs.80 crores, since the tariff would have been fixed according to the loss reduction targets. It is therefore very important that the targets should be achievable but (in the interest of the public) they should be fixed as high as possible.

The innovative target-setting methodology adopted in Delhi was to establish the efficiency improvement targets through the bidding process itself. This is a transparent method by which it has been able to show the public that the best deal possible in the circumstances was obtained. The reduction of AT&C losses has been fixed at a level, which will ensure that distribution in Delhi becomes viable by the end of the five-year period i.e. that the tariff should be completely under control without Government assistance after the end of this period. The opening AT&C losses for each distribution company and the targeted improvements are as follows:

Opening AT&C loss levels approved by DERC

Central/East	57.2%
North/Northwest	48.1%
South/West	48.1%
All	50.7%

AT&C Loss Reduction Targets accepted after negotiations

	2002-3	2003-4	2004-5	2005-6	2006-7
Central/East	0.75%	1.75%	4.00%	5.65%	5.10%
South/West	0.55%	1.55%	3.70%	6.00%	5.60%
North/Northwest	1.50%	2.25%	4.50%	5.50%	4.25%

In case the companies achieve more than the targets originally set by the Government (which are a few percentage higher than those above), the new companies will keep half of the additional benefit as incentive and pass on half of it to their consumers as a rebate on the tariff. It should be remembered that Government retains 49% share in the distribution companies so that the private investors actually get about one-fourth of the additional benefit, which is a very justifiable incentive since once the losses come down it is a permanent benefit to the public.

About tariffs

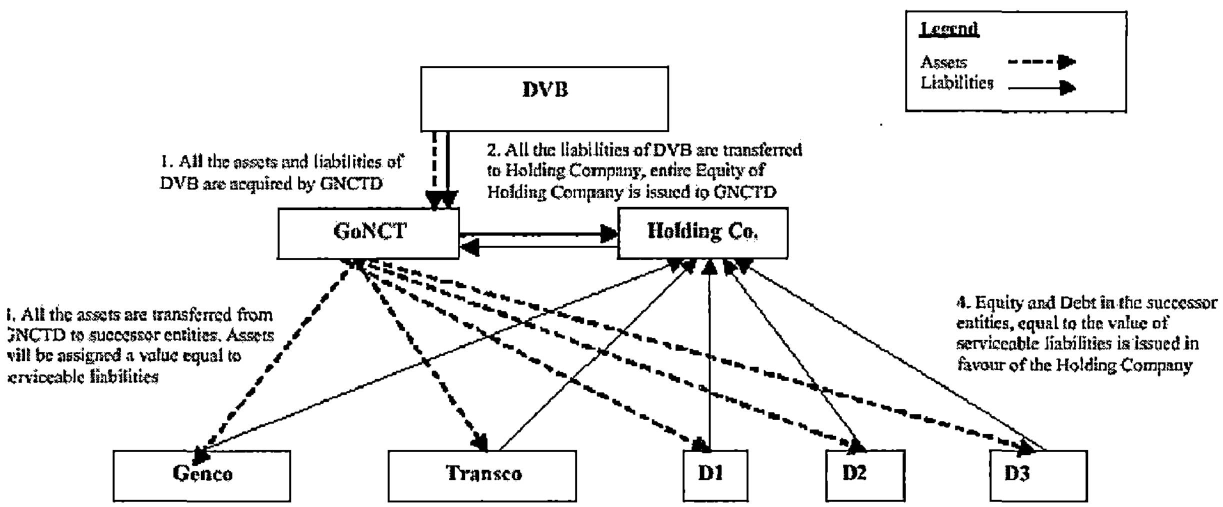
During this interim period after privatisation, the AT&C losses will still be high. Who is to bear the cost? Logically, the answer would be that the tariff should be increased to meet all the allowed cost of distribution including the allowed AT&C losses, but this would impose an undue burden on the public. Therefore, to bridge over this interim period before the industry becomes self-sustaining the Government will be giving a loan assistance of approximately Rs.3450 crores to the Transmission Company, which during this period will be buying power from outside Delhi and from the Generation Company, and supplying it to the distribution companies at a lower rate. It needs to be stressed that this does not helped the distribution company at all, since they are entitled to all their allowed costs, but is purely a means of helping the consumer. This also makes it possible to have differential tariffs for the three distribution companies in order to maintain a common retail tariff throughout Delhi (subject only to slight variation because of the different rebates might earned for overachievement) during this interim period. This is in the public interest because otherwise the losses, and consequently the tariff, might be lower in well-to-do areas than some of the other areas where there is more unauthorised development.

Valuation of the assets

There are different ways of valuing assets. One conventional method is to value all the physical assets taking depreciation into account for each item. Alternatively there are various methods of business valuation. The Department of Disinvestments, Government of India in its manual entitled *"Disinvestments: Policy and Procedures"* advises that physical asset valuation is inappropriate for running businesses and that "business valuation methodologies are generally used for valuation of a going concern". The asset valuation method, it says, "would be relevant only for valuation of assets in case of liquidation of a company". The assets of the Delhi Vidyut Board were valued on a business valuation basis. The method adopted was to take into account the projected efficiency improvements and reasonable retail tariff adjustments, as well as the projected Government assistance, assuming that the electricity business should become self-sustainable within five years.

Dealing with liabilities

DVB and its predecessor DESU accumulated enormous losses, which could not reasonably be passed on to the new companies. Nobody would buy them with heavy outstanding liabilities. Therefore the existing liabilities of DVB were diverted into those, which were serviceable which will eventually be repaid by the successor entities after an initial four-year moratorium and those, which were unserviceable will remain with the Holding Company and have to be dealt with separately. The financial restructuring plan is depicted graphically in the next page:



After the above summary, mainly chronological account, some brief remarks drawn of the Delhi reforms are:

(1) The reforms were an innovative, empirical package sustained over a three-year period by the Government's political objective of privatizing distribution. Circumstances like this are not likely to be universally available in South Asia.

(2) It would have been possible in practice to continue with the Delhi Vidyut Board: while DVB was undoubtedly losing heavily with no prospect of a turnaround, the operational problem in terms of actual cash outflow was not unmanageable for the Delhi Government. Further, Delhi was a revenue surplus territory and the reforms were not driven by any compelling necessity for the Government to obtain external assistance to extract itself from any sort of financial quagmire. Indeed the reforms involved a substantial cash outgo in the first two years, and their financial benefits, in cash terms, would accrue only from the third year after privatisation, which would be after the present Government's term of office.

What drove the reforms was the Government's perception of the electoral consequence of failure to improve the quality of service with its perception that privatisation was the best route for improving the service on a sustained basis and would prove popular with the electorate. It is this that explains much of the difference between the Delhi package and the power sector reforms elsewhere in India, which (in practice, at least) allow the objective of privatisation to be deferred almost indefinitely.

(3) The Delhi reforms were the first to adopt the principle of AT&C loss (the difference between energy input and units of energy for which payment is actually realised) as the measure of commercial efficiency. The conventional measure of T&D loss or unaccounted energy (the difference between energy input and energy billed) no longer generates confidence in India as it became clear that many SEBs were grossly understating the figure.

In Orissa the T&D losses that the SEB had stated as 24% were restated by consultants as 35% and are now conceded to actually have been of the order of 50%. Such "fudging" is achieved simply by inflating the billing figures, which is easily done where much of the billing is on an estimated basis. In fact in Delhi the T&D loss figures were reasonably accurate since all consumers were metered, but the AT&C concept both removed the remaining element of inaccuracy and contributed to investor confidence.

The Ministry of Power has now adopted AT&C losses as a measure of commercial efficiency in all distribution reform programmes generally. (However, it does need to be mentioned that even this calculation remains uncertain where there is continuing uncertainty about the number of units actually billed, since the figure must be derived either by dividing the number of units input by the actual billing rate or by correcting the T&D loss figure by the collection inefficiency; it is still not quite foolproof in States with a large proportion of metered billing.)

(4) Another issue that was addressed more successfully in Delhi than in other States was the personnel aspect, in so far as Delhi alone saw not a single day's disruption of supply on account of the reforms. The Government had been very anxious that there should be no industrial unrest reflected in the stoppage of power supplies particularly in summer. DVB's poor image, and in particular the poor public image of its employees, actually facilitated the reforms since employee leaders were far-sighted enough to realise that any agitation against privatisation would attract little popular support and was unlikely to alter the course of events. They shared the Government's assumption that the reforms were popular with the public and, therefore, wisely focused on protecting the interests of staff through the reform process.

The DVB management did all it could to help in this process by, firstly, organising seminars for a cross-section of employees explaining the necessity of power sector reforms and, secondly, by sending employees' representatives and also senior engineers of DVB to visit other States, in particular to see the working of BSES in Bombay. The agreement signed with the employees protected the interests of all those in position at the time of unbundling against retrenchment, and it protected their retirement benefits; the

Government committed itself to establish and providing funds for a Trust that would take responsibility for the retirement benefits of all such employees.

(5) A basic issue, which the reforms package in Delhi sought to address, was that of regulatory uncertainty. Tariffs, expected improvement of commercial efficiency and transitional finance are the three crucial inter-related issues in any distribution privatisation from a situation of high opening losses. The solution found in Delhi, which has already been described, took into account the fact that multi- year tariffs *per se* were not feasible under the laws in force, and in any case would have been difficult to establish in India given the kind of data available to Regulatory Commissions (or, if they were to be fixed by the Government, to the Government).

The validation of the opening loss levels as left to the Commission since the Commission would have to assess the achievements of each Distcom in reducing losses in subsequent years, but the unorthodox bid procedure adopted (which has been described above) proved the answer to the problem of target setting. This package was of course possible because of GNCTD's willingness and ability to provide transitional finance, without which the Commission would have faced the prospect of having to increase the tariff very sharply indeed and it is uncertain how it would have addressed this issue.

At the time when the reforms were taken up in Delhi, it was felt that multi-year tariff principles that merely set the efficiency improvement targets in advance, and left all else to the regulator's annual exercise of approving Annual Revenue Requirements (ARRs) submitted by the utilities would suffice to allay the anxiety of investors, and in fact did so suffice at the time. This perception may need to be reviewed in future reform packages, in the light of the discussion that will follow regarding post-reform developments.

(5) Finally, the Delhi Government innovated in using its statutory powers to give policy Directions in the face of considerable criticism and opposition at the time.

Presently, the legal framework for reforms in India has changed considerably with the enactment by Parliament of the Electricity Act, 2003 which supersedes all the earlier national legislation on the power industry. The new Act, which came into effect from 10 th June 2003, mandates open access in distribution, as well as transmission, subject to a time schedule for phasing it in, which is to be established by the State Electricity Regulatory Commission, and to additional charges to compensate the distribution licensee for its losses and its obligation to supply all consumers. "Captive Generation" has been completely liberalised, with no permission required and no restrictive definition of the term, and open access without any surcharges.

The Act also supports multiple distribution licenses, making it virtually impossible for the Commission to refuse a distribution license for any area, howsoever small and even without obligation to supply; the SERC is specifically debarred from refusing such an application on the grounds that it would affect the interests of an existing licensee.

While all this is very progressive, it is difficult to foresee at this stage exactly what effect it will have on the structure of the industry. Obviously, if the distribution utility is efficient, it is unlikely to be affected by competition either from those availing themselves of the open access provision or from rival licensees in the same area. However, it remains to be seen whether the threat it poses can, in the existing "political economy," compel or motivate a State owned distribution licensee to be efficient.

APPENDIX-2

APPENDIX-2

BRIEF SUMMARY: CASE STUDY OF POWER SECTOR REFORMS IN U.K*

From an Era of Nationalization to Privatization

Restructuring of the electric power sector in the United Kingdom (UK) is explained in the context of the UK's overall privatization of national enterprises. Privatization was carried out during Prime Minister Margaret Thatcher's conservative administrations, as part of the economic policy to introduce competition to the electricity market and simultaneously minimize the role of government in the national economy.

The regulatory reform itself as well as the process of nationalizing, privatizing, and then introducing major reforms to the electric utility industry in the UK: especially in England and Wales, in this case offer quite an interesting model for deregulation. Not only was the UK the first country to privatize its electricity industry, but it has also become one of the most aggressive and ambitious countries in the world, in terms of restructuring. In fact, several countries in Latin America and Australia have followed the UK's example.

In 1882, the UK's electric utility industry commenced operations under the Electricity Lighting Act. In 1889, through an expansion of the 1882 Act, the first legislative framework was constructed for an electricity supply business intended for customers in a specific region. The UK government passed the resultant Electricity Act in 1926, establishing the central government's authority in electricity matters through a Central Electricity Board (CEB). The Act required the CEB to build and operate a national transmission grid to coordinate a nationwide transmission network and establish a set of common technological standards.

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* Excerpts are taken from:
a)"Digest of UK Energy Statistics" available online at www.dti.gov.uk/EPA/05.pdf
b) "An Overview of the UK Electricity Market" available online at www.mizuho-int.com

In 1947, a national electric power utility was founded to integrate the electric utility industries in England, Wales, and South Scotland under the Labor administration, and the British Electricity Authority assumed responsibility for generation and transmission. Distribution was controlled and managed by 12 semi-autonomous regional distribution boards (area boards) in England and Wales, two vertically integrated companies in Scotland, and one vertically integrated company in Northern Ireland. To expand the role of central government in electricity, the Electricity Act of 1957 was enacted, establishing the Central Electricity Generating Board (CEGB). The act created a firm foundation for government initiatives in the electric utility industry that lasted over thirty years. The Electricity Act of 1983 opened the central electricity grid to IPPs, and became the first step to privatizing and restructuring the electric utility industry in the UK, functioning similarly to PURPA (1978) in the United States. The act obliged CEGB to open the transmission network to private generators and purchase electricity from self-generators, but proved unsuccessful in opening the market.

Six years after the Act of 1983, the Electricity Act of 1989 was enacted, implementing full-scale privatization. By this Act, CEGB was split into four companies: the National Grid Company (NGC), PowerGen, National Power, and Nuclear Electric; the 12 area boards also became regional electricity companies (RECs). Among these new companies, transmission facilities and functional operation of the grid were transferred to NGC; generation assets were transferred to the other three firms.

The Office of Energy Regulation (OFFER) was organized as the UK electricity industry regulator in April 1990, to perform functions analogous to FERC and states' PUCs in the United States.
On January 1 st , 1999, the roles of OFFER and the Office of Gas Supply merged in the formation of the Office of Gas and Electric Markets (Ofgem). Under the new authority, the New Electricity Trading Arrangements (NETA) were adopted, fundamentally changing the wholesale trading of electricity in England and Wales to promote competition so that lower prices might prevail. The NETA went live on 27 th March 2001.

Power Pool Model after the Electricity Act of 1989

The creation of a "power pool" system was the most significant institutional change made in the UK. The UK's form of restructuring differs fundamentally from that observed in the United States in terms of "privatization." The focus in California or in PJM is on the efficient separation of the generation and transmission functions or of the transmission and distribution functions; assets are vertically owned by private entities, in most cases.

In contrast, the UK government (under the Thatcher administration) was able to draw up a blueprint for a new structure on a clean slate through its process of privatization. The administration decided to completely separate ownership of generation, transmission, and distribution, and to form a "pool system," operated by the nationwide, privately owned transmission company, NGC.

Under the Act of 1989, as a competitive market was being created at the wholesale level, generating assets of CEGB were transferred to three established generators: National Power, PowerGen, and Nuclear Electric. Forty conventional generating plants with a combined capacity of 30 GW were transferred to National Power, and another 23 stations with 20 GW of capacity were transferred to PowerGen.

Twelve nuclear power stations were transferred to Nuclear Electric, and the high-tension grid plus 2 GW of pumped storage generation plants were transferred to NGC. These four companies became public limited companies on 31 st March 1990 as the first step for wholesale trading to become feasible in the UK.

The Act of 1989 requires every electric power supplier to obtain a license to provide service. Generation licenses were given to National Power and PowerGen. Nuclear Electric holds a license that is more specific in terms of safety, and IPPs obtain individual licenses. Licenses were also provided for transmission companies and NGC; public electricity supply (PES) licenses were made available for RECs, and second-tier (private electricity service) licenses were made available to other suppliers within authorized PES areas.

Some remarkable points should be made, about the UK market's "mandatory pool" system run by the NGC: the so-called "Poolco system."

All generators whose capacity exceeds 100 megawatts are required to submit their generation units for dispatch by the NGC, but there is no demand-side bidding. Following the demand forecast calculated by Poolco operators from load forecasts made by the RECs, generators bid competitively on a day-ahead, non-discriminatory auction basis. Bidding is managed by NGC's GOAL program, which sets the price as the market-clearing price (MCP), the cost per kilowatt-hour of the final bid taken.

The MCP, in other words, might be considered to be the electric industry's marginal cost, or system marginal price (SMP), as given by the bid amount for a marginal unit in an unconstrained schedule.

On the basis of the SMP, the Pool purchase price (PPP) at which the Pool buys power from generators is determined. The actual PPP is calculated with some consideration for the value of lost load (VOLL) and the loss of load probability (LOLP) in addition to SMP, to take into account financial incentives for preserving peak load capacity in the event that actual consumption exceeds demand forecasts.

Generally speaking, the price paid to generators, or pool input price (PIP), can be calculated as

$$SMP + \{VOLL*LOLP - \max(SMP, \text{bid price})\}.$$

In contrast, the price paid by purchasers, or pool output price (POP), is equivalent to PIP plus incremental charges to cover ancillary services, demand forecasting error, transmission congestion and marginal plant adjustments.

Short Overview of the UK market:

The UK electricity market has undergone a complete transformation since the privatisation progress began in 1990. From just four initially, there are now over 38 major power generators in a market where electricity is now traded like a commodity through bilateral contracts and on power exchanges under New Electricity Trading Arrangements (NETA). There is now also a highly competitive supply segment with over 29 licensed suppliers and consumers free to chose their own supplier (as 38% did in just two years). The distribution (lower voltage transmission) businesses of the former Regional Electricity Companies (RECs) are now separate regulated monopolies but after several tough years, regulatory pressures have eased considerably. Meanwhile the National Grid has retained monopoly ownership of the UK's high voltage power lines and is subject to a transmission price control. The industry regulator is ofgem.

In more detail, the four segments of the UK electricity market are as follows;

Generation: Since privatization commenced in 1990, the power generation market in England and Wales (E&W) has been transformed from a highly concentrated market with a few portfolio players to a market with many diverse generating companies including merchant generators often owning only one plant. There are now 38 companies regarded as major power producers with a much reduced market share for the largest generators. This includes Centrica (the gas company) which has recently acquired power generating assets to help mitigate its exposure to commodity price rises. Roughly one-third of the generating capacity in E&W is also owned by non-UK entities.

Transmission: This activity covers the bulk transport of electricity by high voltage power lines from power stations to grid supply points. The transmission system in E&W is generally referred to as the National Grid Company (NGC), the transmission network operator in England and Wales.

NGC has a central role in the industry. It has a statutory duty to develop and to maintain an efficient, coordinated and economic transmission system and to facilitate competition in supply and generation. The National Grid must ensure that the system in England and Wales is balanced nationally and locally at all times, taking into account and resolving all constraints on the transmission network. The charges for connection to and use of the transmission system are subject to a transmission price control.

It also owns and operates jointly with Electricite de France, the interconnector between the systems of England and France. It also owns jointly Scottish Power and Scottish and Southern Energy the interconnector with Scotland. A number of other interconnectors, with the Republic of Ireland, Norway and the Netherlands are currently under consideration.

Distribution: This activity is the transport at a regional level at gradually reducing voltages from National Grid supply points to final customers, both commercial and domestic. The only legally authorised distributors are the 14 RECs (twelve in E&W and two in Scotland).

Distribution remains a monopoly business and under the Utilities Act 2000 it has become a separately licensable activity. This Act required the RECs to place their distribution businesses in separate subsidiaries, completely separate from their supply activities. Reflecting its monopoly status, distribution prices are subject to pricing controls. After several years of very severe price reductions, regulatory pricing pressures have recently eased off with the current pricing formula at RPI-3% which lasts through to 2005.

Supply: This is the process of buying electricity in bulk and selling it on to the final customer. Suppliers pay for the electricity to be transmitted across the National Grid and the local RECs distribution network to their customers.

Competition in supply has been progressively introduced and from July 1999, it became fully deregulated such that all consumers are now free to choose their own electricity supplier. Competition was introduced in the large customer market covering 5,000 customers with a maximum demand of 1MW and above in April 1990. Now, more than 80% of customers in this market are supplied by a non-local supplier.

In April 1994 freedom of choice was extended to 50,000 medium sized customers with a maximum demand of 100kW-1MW of which about half are now supplied by non-locals.

The last segment was the UK's 26 million customers with an annual consumption up to 12,000kWh which includes domestic and small business customers and this was progressively opened up for competition between September 1998 and May 1999. Within two years of competition being made available to this last category of consumer, around 11 million or 38% of customers had switched supplier at least once and the process is continuing. At the same time, some 23% of customers in this last category have reportedly switched more than once with about one-third returning to their original supplier. In most instances, the ability to receive gas and electricity jointly from one supplier has been the most important reason for switching. About 81% of those who have switched are on dual fuel deals with about half switching their gas supplier to their electricity supplier. About 30% of all customers are on dual fuel deals.

There are 29 electricity suppliers licensed to operate in the UK.

Implementation of the New Electricity Trading Arrangement (NETA):

From its inception, the UK's Poolco market system has exhibited some problems. For example, price cap regulation's employment of RPI-X as the transmission price control, as mentioned above, has stimulated much controversy, such as regarding which figure should be adopted for the X factor, or whether RPI is a suitable index for regulation. Joskow (2001) has identified two more problems:

1) wholesale prices have been excessive, associated with market power being exerted by the two largest generating companies created at the time of privatization, and
2) 2) too few benefits have reached customers in the form of lower prices. Also, the single market allows no market-to-market basis competition.

To better align electricity prices with generating costs, the government introduced the New Energy Trading Arrangements (NETA) in March 2001. Under this system, bulk electricity is traded like a commodity between generators and suppliers through bilateral contracts by means of submitted bids and offers on power exchanges.

Under NETA, each generator effectively becomes self-dispatching (rather than being centrally dispatched by NGC) which has resulted in a greater emphasis on the reliability of generating plant.

Suppliers, purchasers, and probably marketers, too, can transact voluntarily, primarily through forwards and futures contracts in the absence of regulation except for the Balancing Settlement Code (BSC), which governs NETA's basic function as an imbalance settlement and Balancing Mechanism (BM).

All generators, transmission companies, distribution companies, and other electricity service providers must sign up with the BSC to be BSC Parties licensed to offer service at each level. BSC is managed by a separate company, ELEXON.

NETA Functions I: Imbalance Settlement

Imbalance settlement is the procedure for pricing and settling surpluses and deficits between the contractual volume of generation (or demand) and the physical or metered volume of generation (or demand). It is not the process for pricing and settling bulk purchases and sales of electricity.

Under NETA, all metered data is available on a half-hourly basis, so Imbalance Settlement also functions half-hourly. That is, imbalance volumes and prices are calculated every half hour, and settled daily. The Imbalance Settlement comprises several basic concepts.

Gate Closure is the time limit that occurs 31/2 hours prior to the start of every half hour of actual operation.

A Balancing Mechanism unit (BM unit) is a basic operating unit participating in BM whose capacity exceeds 50MW.