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# Restructuring of Indian Power System with Micro Grid

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***Abstract:*** ***Indian power system is a vertical power system, where power generating station is at the top and customers are at bottom. Most of the electricity produced today is generated in large generating stations, which is then transmitted at high voltages to the load centers and distributed among consumers at distribution level voltage through local distribution systems. This system leads to monopoly in the market. This leads to less chance of innovation in power system. Now power generators become vital they don't take any risk in order to improve performance of the system and leads to poor quality of power.***
***Restructuring of power system can be done by unbundling the power system. Generation, transmission and distribution will be performed by different company, which are independent. The structural components representing various segments of the restructured electricity market are Generation companies (GENCOs), Distribution companies (DISCOs), Transmission companies (TRANSCOs), an Independent System Operator (ISO) and a Power Exchange (PX).***
***Continuity of supply is important than the cost of the electrical energy. To meet the growing power demand, electric power industry has to adopt the renewal sources of energy. Solar and wind energy are very important in his context. For meeting the demand of electricity we should merge the concept of restructuring with micro grid. A Micro grid is any small or local electric power system that is independent of the bulk electric power network and having own sources. Restructuring the power system makes it open market. So it invites private companies to establish the micro grids and utilize renewal sources of energy. The objective of this paper is to evaluate the way of restructuring the power system to meet the growing demand of power with maintaining the quality of power.***
***Keywords— Generation companies (GENCOs), Distribution companies (DISCOs), Transmission companies (TRANSCOs), Independent System Operator (ISO), Power Exchange (PX).***

## I. INTRODUCTION

Indian power system is a vertical power system, where power generating station is at the top and customers are at bottom. Power flow takes place in downward direction. Major power stations are thermal hydro and nuclear power stations which are far from the domestic areas. So power is transmitted using high voltage transmission lines. At both the end of transmission line a grid is present where voltage level of power is controlled as per the requirement.

There is a local monopoly, in the sense that in any area one company or government agency sold electric power and services to all customers. The major difference between conventional monopolistic electricity market and the emerging deregulated market is that electricity in the first case is considered as merely energy supply sector, where as in the second case it is treated as a service sector and is to be marketed like any other common commodity. In a monopolistic market, the same agency is responsible for power generation, transportation, distribution as well as control, whereas in the new market structure these tasks are segregated and have to be separately paid by the transacting parties.

Now a day center of attraction is renewal energy sources. Many small power stations are installed which are based on the renewal energy sources. These generating stations are very small in capacity and can be installed near the residential areas. These generating stations have to supply the power to nearest grid. So there is a monopoly in the market. This make Power industry generator centric instead of consumer centric.

This leads to less chance of innovation in power system. Now power generators become important they don't take any risk in order to improve performance of the system. This leads to poor quality of power. Generators don't make any investment for better power quality because there is no competition in the market.

### *A. Problems with conventional power system*

*1)* No competition in the market which leads in poor quality of power.
*2)* Less chance for innovation and implementation of new technology.



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*3)* Power industry is ruling so power cost is not effective.

These are some of the problems which show the need of restructuring of power system.

## II. RESTRUCTERING OF POWER SYSTEM

Restructuring of power system can be done by unbundling the power system. Generation, transmission and distribution will be performed by different company, which are independent. Different generating units will be independent and need not to supply the power to grid any more. They can supply directly to consumers or grid as per their convenience. Distribution companies are independent of generation and transmission companies and are directly connected to the consumers. There are numbers of company participate in each stage, which introduces competition in electrical power industry. Now consumers have options to choose the electricity provider. It creates a healthy market competition environment. Now power sectors main aim is to attract the customers. They have to concentrate in power quality as well as cost. It makes electrical power system customer centric instead of generator centric.

The structural components representing various segments of the deregulated electricity market are Generation companies (Gencos), Distribution companies (Discos), Scheduling Coordinator (SCs), Transmission companies (TOs), an Independent System Operator (ISO) and a Power Exchange (PX).

Electrical energy could not be stored in large quantities. Continuity of supply is important than the cost of the electrical energy. To meet the growing power demand, electric power industry has to adopt the renewal sources of energy. Solar and wind energy are very important in his context. For meeting the demand of electricity we should merge the concept of restructuring with micro grid concept. These two can work together for continuous supply of power. Micro grid is the basic component in restructuring the power system.

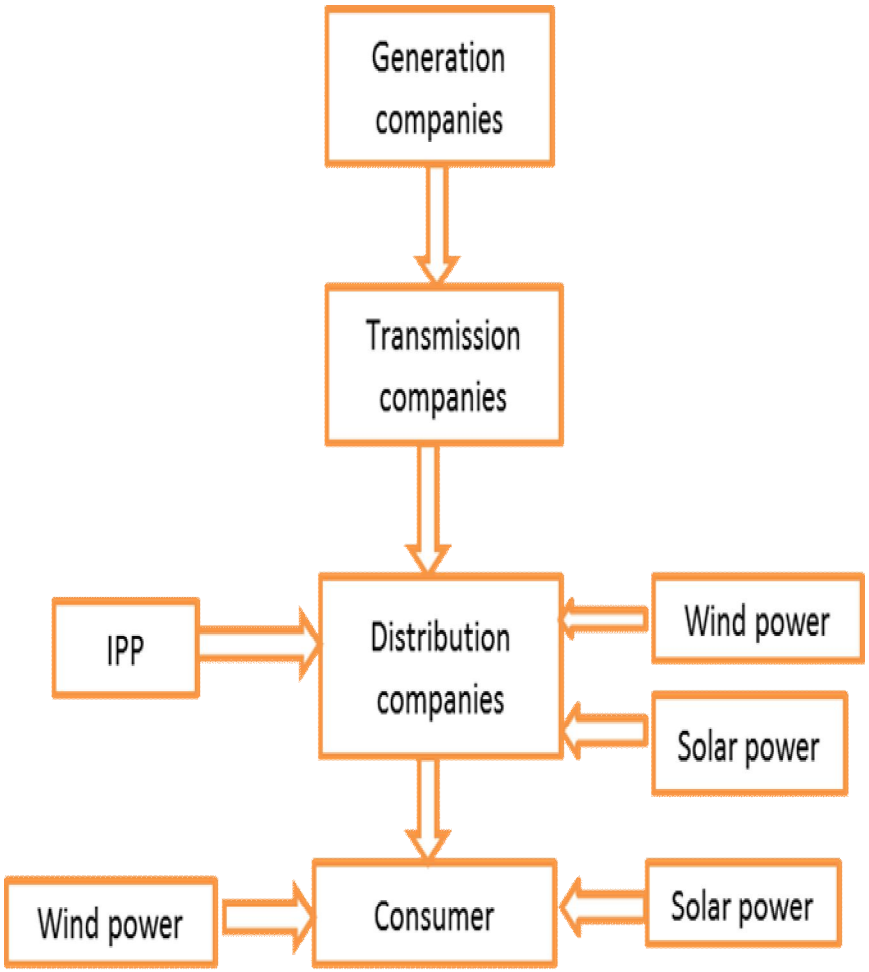


Fig. 1 Power flow in restructured power system


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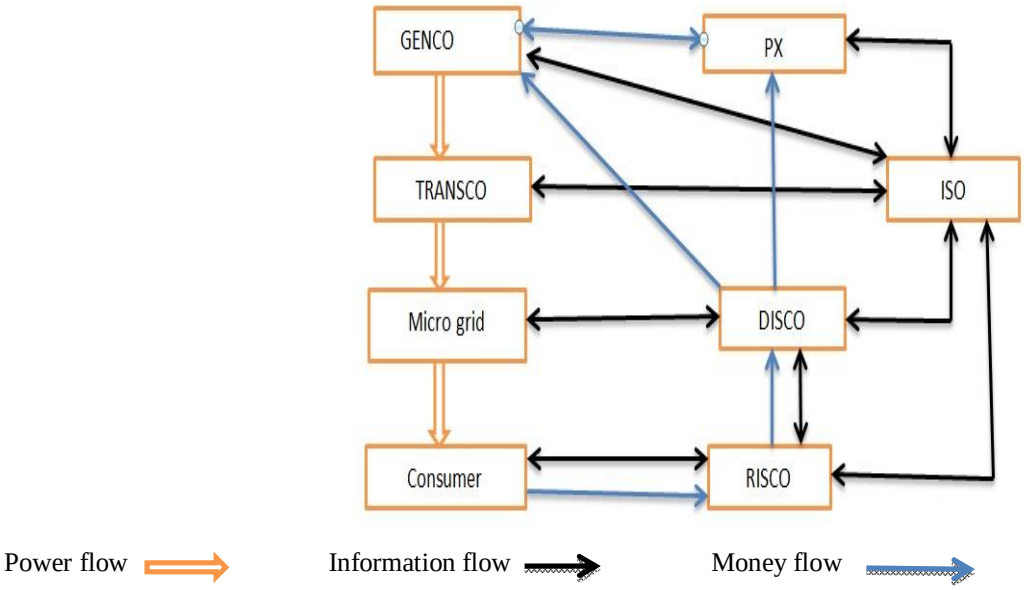


Fig. 1 Restructured power system

## III. COMPONENT OF RESTRUCTERED POWER SYSTEM

*A. Genco*

These are power generation companies including major power generating companies like NTPC, NHPC. It also includes the individual power producers (IPP) and captive power plants (CPP). The main aim of these companies is to produce the power.

*B. Transco*

These are companies which play the role of power transfer. As major the power plants are far away from residential areas. So transferring the power is major task which is performed by the TRANSCO. Laying transmission line, protection of transmission line and compensation in the line is take care by these companies.

*C. Disco*

These are companies who play same role as in traditional power system in distribution side. But now there is a major difference that there is a competition in market. So they have to come with better service, better pricing and better tariff. Now their major challenge is to sell the power.

*D. Risco*

These are retailers. They are directly not connected to the power system. Their responsibility is aware the consumers from different tariff plans to the consumer and sell the plans of different DISCO. They are not in power flow but they are connected in money flow.

*E. Power Exchange (PX)*

The PX handle the electric power pool, which provides a forum to match electric energy supply and demand based on bid prices. It provides a market to the GENCO to sell their power to DISCO. Everyday bidding is done for day after tomorrow. The lowest bid wins and will supply the power on respected day.

*F. Independent System Operator (ISO)*

The role and responsibilities of ISOs vary widely. The ISO has three objectives namely, security maintenance, service quality assurance and promotion of economic efficiency and equity. There should be someone to take care of system stability. It gathers the data from all the points and processes them for successful operation. All the legal action is taken by ISO. It performs the job of load scheduling, deal with outage and emergency, monitor system operation and security and protection of the system. It also certifies the GENCO, TRANCO and DISCO.

## IV. WORKING OF RESTRUCTURED POWER SYSTEM

At power exchange everyday bidding is takes place for supply of power for day after tomorrow. The company which wins the bid is


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responsible for the supply of that amount of power on respective day. TRANCO have the agreement GENCO and DISCO for transmission of power. The power is given to the micro grid. From there power is supplied to the consumers. There will many DISCO present in the market having different pricing and tariffs. Retailer's aware them with these plans. They are link between customers and DISCO. Independent System Operator (ISO) doesn't participate in power flow. It monitors the whole process and is responsible for smooth operation of the system. It decides the standards for companies and takes care of system security.

## V. INTRODUCTION TO MICRO GRID

A Micro grid, a local energy network, offers integration of distributed energy resources (DER) with local elastic loads, which can operate in parallel with the grid or in an intentional island mode to provide a customized level of high reliability and resilience to grid disturbances. This advanced, integrated distribution system addresses the need for application in locations with electric supply and/or delivery constraints, in remote sites, and for protection of critical loads and economically sensitive development

A Micro grid is any small or local electric power system that is independent of the bulk electric power network. For example, it can be a combined heat and power system based on a natural gas combustion engine (which cogenerates electricity and hot water or steam from water used to cool the natural gas turbine), or diesel generators, renewable energy, or fuel cells. A Micro grid can be used to serve the electricity needs of data centers, colleges, hospitals, factories, military bases, or entire communities (i.e., "village power").

A Micro grid is a group of interconnected loads and distributed energy resources within clearly defined electrical boundaries that acts as a single controllable entity with respect to the grid. A Micro grid can connect and disconnect from the grid to enable it to operate in both grid-connected or island-mode.

### *A. Importance of Micro Grid*

*1)* Enables Grid Modernization.
*2)* Enables integration of multiple Smart Grid technologies.
*3)* Enhance the integration of Distributed and Renewable Energy Sources.
*4)* Facilities integration of combined heat and power (CHP).
*5)* Promotes energy efficiency and reduces losses by locating generation near demand.
*6)* Potential to reduce large capital investments by meeting increased consumption with locally generated power. (Local generation may lower investment in the macro grid).
*7)* Encourages third-party investment in the local grid and power supply.
*8)* Potential to reduce peak load.
*9)* Meets End User Needs.
*10)* Ensure energy supply for critical loads.
*11)* Power quality and reliability controlled locally.
*12)* Promotes community energy independence and allows for community involvement in electricity supply.
*13)* Designed to meet local needs and increase customer (end-use) participation.

## VI. TYPES OF MICRO GRID

### *A. Island-mode*

An isolated island micro grid system is a specialized small to medium-sized independent power system that inherits the original micro grid characteristics and that aims to maintain the quality and to ensure the reliability of power in an independent system when large amounts of renewable energy are introduced. Countless inhabited islands exist worldwide, the majority of which are supplied with electric power by independent systems.

In independent power systems for isolated islands, due to problems with operational constraints and the like, power is typically supplied from internal combustion power generators, which use fossil fuel and have a relatively large Carbon die oxide emission factor. Additionally, the transportation of fuel to remote areas adds to the cost of power generation, and economic efficiency is an issue for isolated islands.

### *B. Grid-connected*

These are connected to the grid at one end and at another they have their own energy sources. These renewal energy sources are basically solar and wind generators. Highly available power grids may act as an additional source for micro-grids. Direct connection



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of ac micro grids to a large power grid facilitates stable operation but only if the power grid acts as a "stiff" source to the micro grid. When using renewable energy sources, a grid connection may allow reducing the need for energy storage in the micro grid. If not all loads in a micro grid are critical, a grid connection may allow to reduce the investment in local generation. Micro grids are typically planned with extra capacity with respect to the local load. This extra power capacity can be injected back into the grid in order to obtain some economic benefit. Grid interconnection allows to reduce fuel operational costs by using the grid at night when electricity costs are low.

## VII. ROLE OF MICRO GRID IN RESTRUCTERING

India is a growing county so power is a basic need for development. We have power production which is less than total demand. So we have to restructure the power system with increasing power production. In this renewal energy sources can play a vital role. These renewal sources fuels comes free of cost and minuteness is also less.

India is basically a country of villages. There is almost 60 percent of population live in villages and providing power to them is a big task. As initial cost for solar and wind energy is much higher so it is not possible for government to establish it in all the villages. So there comes restructured power system. As this restructuring make market open place so now private companies can do this with and sell the power to the villages. This bring the concept of restructuring with micro grid.

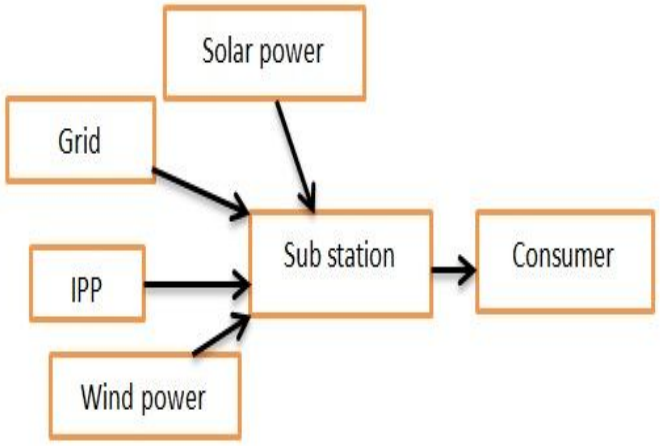


Fig.3 Grid connected power system

Here a grid connected micro grid is shown. Here different power generating units are connected to a substation. Solar power and wind power is given first priority. So whenever there is power available from these sources they are utilized first. But there is a problem with these sources there frequency and voltage level in not constant, these are flooding. So we have to make some arrangements to get a stable output voltage and frequency. These sources are also not constant power generating sources. So this is also connected with the grid for smooth operation of the system. Some IIP may also connect with the substation. This makes system more reliable and secured.

### *A. Benefits*

*1)* Support the integration of renewable resources.
*2)* Improve reliability and power quality.
*3)* Support emergency operations.
*4)* Optimize energy usage.
*5)* Enable participation in new markets for demand response and ancillary services.
*6)* Storage integration maximizes renewable usage and free fuel.

## VIII. CONCLUSION

In this paper we have discussed possible model of restructured power system. For being a developing country we have to meet the power demand first. Renewal energy sources can be best solution for this because they come with free of cost. Private sector can play a vital role in this. So must open our power market for all the private sectors. We have to transform this sector into business so consumer will become customers.


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this work can be further extended to make the power market more efficient. Micro grid can implement smart grid technology and give better control over power flow.

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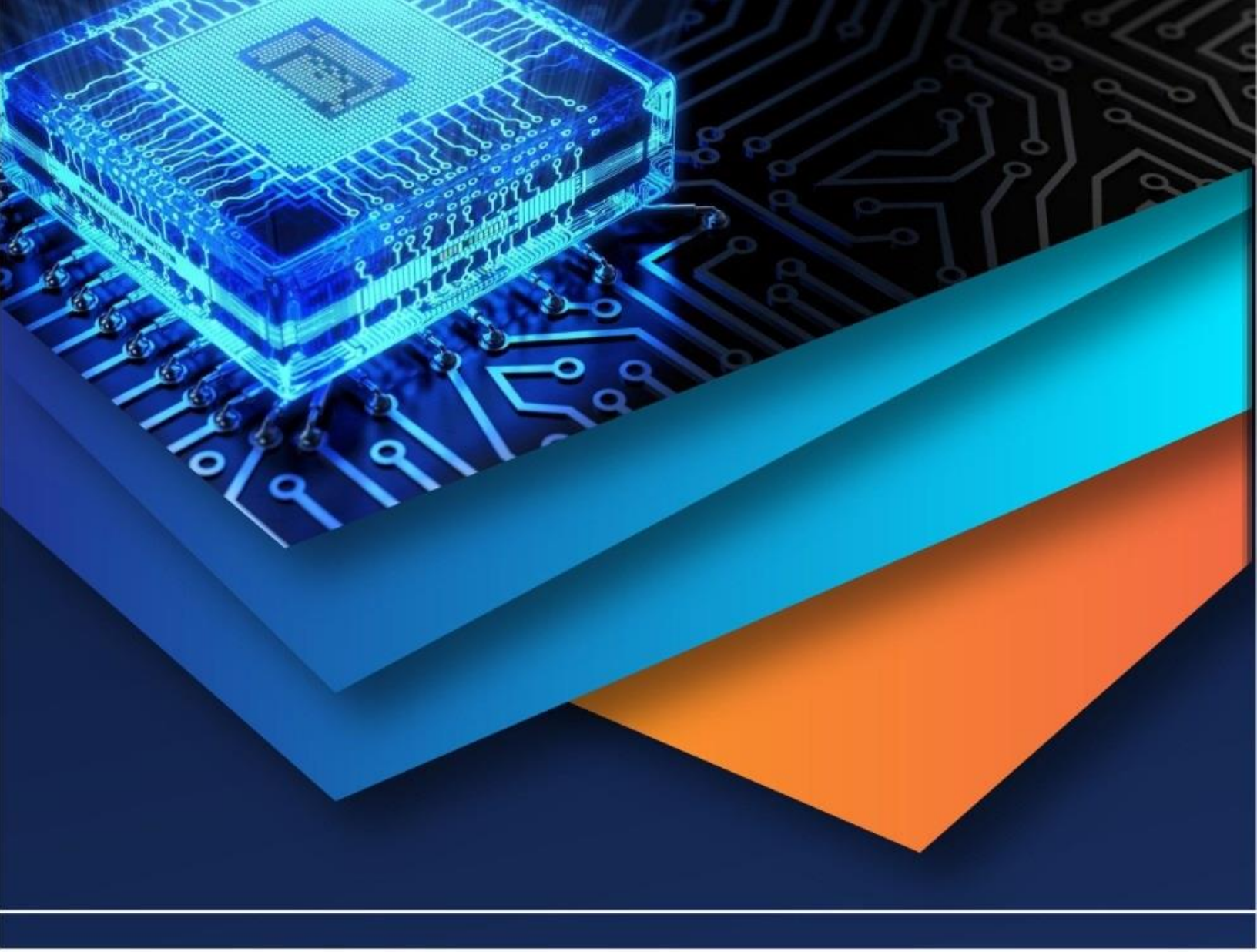

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