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"CAPTIVE POWER - IMPORTANCE, GROWTH & FORCAST"

BY

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A DISSERTATION REPORT SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIRMENTS FOR

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ACKNOWLEDGMENT

APPENDIX – II

ACKNOWLEDGEMENT

This is to acknowledge with thanks the help, guidance and support that I have received during the Dissertation.

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I also place on record my appreciation of the support provided by **Mr. Samuel Kutty P.S** (name of the Librarian) and other staff of **S&W Library** (name of the Library).

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A DECLARATION BY THE GUIDE

APPENDIX – III

A Declaration by the Guide

On Company Letter Head

Declaration by the Guide

This is to certify that the ~~Mr~~/Ms ANKITA DOBHAL, a student of (**EMBA – POWER MANAGEMENT**), **Roll No** 500024714 of UPES has successfully completed this dissertation report on **"CAPTIVE POWER: IMPORTANCE, GROWTH & FORECAST "** Under my supervision.

Further, I certify that the work is based on the investigation made, data collected and analyzed by him and it has not been submitted in any other University or Institution for award of any degree. In my opinion it is fully adequate, in scope and utility, as a dissertation towards partial fulfillment for the award of degree of MBA/BBA/B.Sc.

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LIST OF ABBRIVATION

IV .LIST OF ABBRIVAION

(a) "ABT" means Availability Based Tariff;
(b) "Act" shall mean the Electricity Act, 2003 (36 of 2003) and subsequent amendments thereof;
(c) "Billing cycle" means a period of one month commencing from 00.00 hours on the first day of the month and ending at 24.00 hours on last day of the month;
(d) "Captive Power Plant (CPP)" shall have the meaning assigned to the term under clause 2.3 of these regulations;
(e) "Captive User(s)" shall have the meaning assigned to the user
(f) "SERC or Commission" shall mean the State Electricity Regulatory Commission;
(g) "Conventional Fuel" shall mean any of the fossil fuels such as coal, lignite etc.
(h) "Day" shall mean a continuous period of 24 hours;
(i) "ERLDC" shall mean Eastern Regional Load Dispatch Centre;
(j) "Firm Power" shall mean the power agreed for supply by a CPP to a Distribution Licensee in the Power Purchase Agreement executed between the Distribution Licensee and the CPP. The variation up to plus or minus 10% from the agreed capacity shall be treated as firm power;
(k) "Firm energy" shall mean energy corresponding to Firm Power
(l) "Grid Code" shall mean the JSERC (State Grid Code), Regulations, 2008 & its amendment from time to time and the Indian Electricity Grid Code.
(m) "In-firm Power" shall mean the power supplied by a CPP to a Distribution Licensee if it is less than 90% or more than 110% of the Firm Power as defined above;
(n) "In-firm energy" shall mean energy corresponding to In-firm Power
(o) "Licensee" shall mean a Distribution Licensee operating within the state ;
(p) "Open Access Regulation" means the JSERC (Open Access in Intra-State Transmission and Distribution) Regulations, 2005 and its amendments from time to time;
(q) "Stand-by period" shall mean a period worked out by the Licensee as per the procedure for requisitioning Stand-by support as provided in these Regulations;
(r) "Stand-by support" shall mean the contractual arrangement between the CPP user and the Distribution Licensee of his area of supply to provide power in case of planned or forced outage of the CPP;
(s) "State Sector Generating Station" shall mean any power station within the State, except the Inter-State Generating Station located within the State;
(t) "SLDC" means the State Load Dispatch Centre (established under subsection (1) of section 31 of the Act) to ensure integrated operations of the power system and coordinating supply-demand in the state in real time;
(u) "TYPE A CPP" shall mean CPP which is not connected to the grid
(v) "TYPE B CPP" shall mean CPP which is located within the premises of the captive user and connected to grid.
(w) "TYPE C CPP" shall mean CPP which is located at premises other than that of the captive user (x) CSS Cross Subsidy Surcharge

(y) "EA" Electricity Act 2003
(z) "KW" Kilowatt
(aa) "MW" Megawatt
(ab) "NEP" National Electricity Policy
(ac) "NTP" National Tariff Policy
(ad) "PLF" Plant Load Factor
(ae) "PPA" Power Purchase Agreement
(af) "REC" Renewable Energy Certificate
(ag) " RLDC" Regional Load Dispatch Centre
(ah) "ROE" Return On Equity
(ai) " RPO" Renewable Purchase Obligation
(aj) " RPPC" Rajasthan Power Procurement Committee
(ak) "SEB" State Electricity Board

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VIII. EXECUTIVE SUMMARY

The power sector in the India is undergoing the restructuring process. Moreover, during the last decade the India has witnessed a phenomenal growth in the load demand, consequently a huge amount of generation is added to the electric utilities to meet the load .India has a huge power shortage (demand supply gap), which is retarding the nation's progress. Hence, we need to work simultaneously on all fronts to increase the availability of power. Captive power plants (CPPs) have been installed by many industries and commercial establishments all over the country,

Captive power Plants are developed to cater the industrial demand in the scenario where the electricity supplied by the utilities is short in supply or is of bad quality. Captive plants over the years have been evolved from plants owned by single promoter to group captive to the medium of maximizing the benefit by selling its surplus power.

With provision in Electricity Act 2003 for wheeling of captive power through open access and emphasis given to captive power in National Electricity Policy (NEP) 2005, surplus power from captive power plants were emerging as a important source of electricity supply for fulfillment of demand.

Government is also making a conscious attempt to encourage captive generation by earmarking the coal blocks to be dedicatedly used by these plants. Captive generator has a number of fuel options today. The choice could be between oil, natural gas, naphtha, biogas or coal.

Availability of open access is the major issues related to the strengthening of intra state and inter-state transmission network, reasonable tariff and availability of additional fuel required by captive power plants.

Harnessing the surplus power from the Captive Power Plants has the following advantages:

-Partially bridge the gap between Demand & Supply.
-Optimize the investment made in CPPs
-Improve the efficiency of CPPs by operating at a higher PLF (Plant Load Factor).
-Additional revenues could be generated by the CPPs by sale of surplus power.

This report consists of detailed study of regulatory framework for Captive power plants in India as well as in the different state by intensive study of the existing provisions in the Electricity Act 2003, National Electricity Policy, Captive Power Policy, and National Tariff Policy, Also the various ways that how can sell its surplus power.

CHAPTER 1: INTRODUCTION

CHAPTER 1: INTRODUCTION

1.1 OVERVIEW:

Adequate electricity supply plays a central role in development and realization of the country's economic goals. Economic growth gets impeded both by poor electricity supply quality and electricity supply interruptions, particularly in the peak period. To reduce the gap between supply and demand for electricity as well as to make best use of energy resources, the captive power plants (CPPs) are certainly good, reliable options. Captive Power Plants (CPP's) are defined as the power plant set up or proposed to be set up by an industry, institution, a person, or a group of persons to meet their own power requirements .It is expected that there would be increase in private generation companies and captive plants. Quantum of such plants is likely to grow in the coming decade.

- **OBJECTIVES OF REPORT:-**

- ✓ To study in detail the India Power Scenario and Captive Power Scenario in India including legal regulations, policies & further prospects.
- ✓ To study captive power plant - issue, growth, way to forward and forecast in India.
- ✓ To study the SALE of power and SALE of surplus power.
- ✓ To study in detail the Power Scenario in the state U.P and captive power plants.
- ✓ How captive power plants have been utilized for cost efficiency and increased
- ✓ Case study about Performance Monitoring of Captive Power Plant availability in grid power in Delhi International Airport Private Limited (DIAL).

1.2 BACKGROUND:

In spite of a total installed power generation capacity of about 271.722 GW as of end March 2015.India is still struggling to meet increasing power demand. Government of India came up with the Electricity Act in the year 2003 to reform the unorganized power sector in India. EA-2003 has helped to improve efficiency and has brought some much needed order in the overall power sector. However, we are still facing severe power cuts and many regions in India are still lacking something as basic as an electricity connection. Recent structural reforms in the power sector will take some time for complete implementation. In the short to medium term, supply-demand mismatch and limited ability of the financial systems to support subsidies are expected to push consumer tariffs upward. Tremendously growing power demands as a result of sophisticated and materialistic life styles have put the utilities on odds. The utilities are not able to cope with the increasing power demands and also technically it is not possible to erect and operate power plants at the same pace as that of changing power demands. Under such situations, the captive power comes in to picture.

1.3 PURPOSE OF THE STUDY

Electricity Act - 2003 has made the generation free from licensing and invited the private players to participate in Indian Power Sector. In view rising Tariffs of SEBs/utilities & unreliability of power supply captive generation is becoming more & more feasible & attractive proposition for large HT & EHT consumers. The study has an objective significance of exploring the type of industry most extensively using or likely to use the captive power plants rather than rely on grid power supply. It also covers the benefits associated with the usage of captive power plant .Captive power Plants are developed to cater the industrial demand in the scenario where the electricity supplied by the utilities is short in supply or is of bad quality. Captive plants over the years have been evolved from plants owned by single promoter to group captive to the medium of maximizing the benefit by selling its surplus power. Captive generation is an important means to making competitive power available. Appropriate Commission should create an enabling environment that encourages captive power plants to be connected to the grid.

1.4 RESEARCH HYPOTHESES:

In the last twenty years the electricity power sector in both developed and developing countries has been subject to restructuring. Although the approaches to reform have varied across countries, the main objective has been to improve the economic efficiency of the sector by introducing private capital, liberalizing markets (introducing the captive power) and introducing new regulatory institutions. In economic theory, ownership and the degree of competition are both important factors in determining output levels, costs of production and prices. More formally, the capital market and the product market determine the levels of allocative and productive efficiency. Therefore, privatization, competition and more effective state regulation of monopoly activities should lead to improved economic performance. This depends, however, on the reforms being appropriately designed and implemented. A country implementing reforms can suffer from serious institutional weaknesses, meaning that the planned reforms may not produce their intended benefits. Thus, the impact of privatization, competition and regulation on the electricity sector may produce different results depending on the design and its implementation since India & Argentina both, have carried reforms, but the methodology has been different. In order to determine which method has been more powerful in bringing the desired changes, the following hypothesis have been set

- **H1: Captive Power plant will bring in economic & productive efficiency in the power sector.**
- H1.1 Captive power plant by way of green field projects than divestures will lead to higher labour generation per capita.
- H1.2 Captive Power plant by way of green field projects than divestures will lead to

higher installed capacity per capita.

- H1.3 Captive power plant by way of green field projects than divestures will lead to Higher installed generation per capita.

- **H2: A sound policy and regulatory framework and efficient supporting institutions to enforce the relevant laws and regulations are imperative for INDIA to enter and thrive.**

CHAPTER 2: LITERATURE REVIEW

CHAPTER 2: LITERATURE REVIEW

Price Water House Coopers made a report on Infrastructure development action plan for Chhattisgarh in which captive scenario in India was mentioned. The report mentioned that industrial sector is one of the largest consumers of electrical energy in India. However, a number of industries are now increasingly relying on their own generation (captive and cogeneration) rather than on grid supply, primarily for the following reasons: non-availability of adequate grid supply, poor quality and reliability of grid supply and high tariff as a result of cross subsidization. The captive power plant owners have some concerns regarding tariff structure for surplus power sold to the grid, no risk sharing in case of non-availability of fuel, need to devote time and energy to an activity, which is not their core business. The growing importance of captive power plants have also affected SEBs like there is an adverse impact finances of the utilities, loss of HT consumer.

While the research which is conducted by Bureau of Research on Industry and Economic Fundamentals (BRIEF) ,where data in the report paints a rather grim picture of the current scenario in the power sector, the survey results show a different view. Where the data suggest that India Inc may be negatively impacted by the power situation of the country, it was surprising to discover that other than an increase in costs mainly that in fuel, there was minimal impact of power failures and outages on the various businesses. It revealed that the business owners across the country have adapted rather well, by installing back up or captive units negated the impact on operations, production and various other processes of their enterprises. The original premise that power failures, especially the larger „black outs‟, were seriously negatively impacting Indian business, may not hold true after all.

2.1 REVIEW AREA :

- Identifying a Captive power plant application in Power Sector.
- Determining various Policies which can be used in Captive Power plant.
- Identifying a potential of emerging Captive power to address a challenges and opportunities in our power sector to meet the demand.

2.2 FACTORS CRITICAL IMPORTANT FOR STUDY:

Main factors that increase the Demand:-

- India Manufacturing sector growing faster than in the past.
- Residential consumption growing 16 % over the next 10 years.
- The connection of 135,000 villages to the grid through several programs that aspire to provide power for all by 2014
- Realization of demand suppressed due to load shedding.

Various statistical tools are used:

- Excel spreadsheets are used to extract a data as per requirement.
- Excel sheets are used to represent a data in tables & certain calculations; sorting etc. are done using excel sheet formulae.
- Percentages, mean, median mode are used for data analysis.
- Graphical representation of data is done through pie charts, bar graphs, lines.
- Various diagrams and flow charts from a research papers are used to represent a analysis.

2.3 SUMMARY:

There are many industries which consume a large chunk of the power generated and distributed by the utilities. The sustained electricity demand-supply gap, lack of reliable power supply from the grid and high tariffs are key reasons for industrial consumers to consider the power option. As these industries also provide the larger portion of the revenue, they have to compete consistently in the global market for their products and services. Non-availability, poor quality and reliability of grid power along with exorbitantly high tariffs have a significant impact on the competitiveness of the industry in market. Being a part of such scenarios and facing the related issues, there came a need of sufficient power supply to these industries. And then this led to the emergence of captive generation. Current power scenario of India is shackling India's growth story. The lack of affordable and quality power is impeding the potential that the Indian industry can achieve. The key issues with the current state of power. First, the installed capacity in the country is clearly lacking. The demand outweighs the supply and thus the country's industry as well as its general society is riddled by frequent power shortages. Firms are facing cost escalation, losses in revenue, increased consumption of fuel, increased investment in captive facilities, higher inventory costs and loss in competitiveness and many other issues that are seriously detrimental to the health and stability of the Indian industry. Following conclusion this study will indicate.

- The study will indicate the total amount of captive power in the India.
- Also indicate that captive generation is a cost effective &reliable option for various industries.
- Also there is needed to develop guidelines and policies regarding captive power which should
- Be plausible and practical.
- Also find out the major users of captive power with the help of database.

CHAPTER 3: RESEARCH DESIGN, METHODOLOGY AND PLAN

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3.1 DATA SOURCES

Sources of Data Collection A data collected through:-

a) A literatures and a website of a organization.
b) Various websites for a literature for a project.
c) Text books & magazines.

3.2 RESEARCH DESIGN

The study design comprises of four key elements: collection and analysis of data from secondary sources; collection and analysis of primary data through questionnaire survey of a sample of CPPs; interviews with the captive plant owners and interviews with experts from industry and academics.

FIG 1: MAIN STEPS OF RESEARCH DESIGN

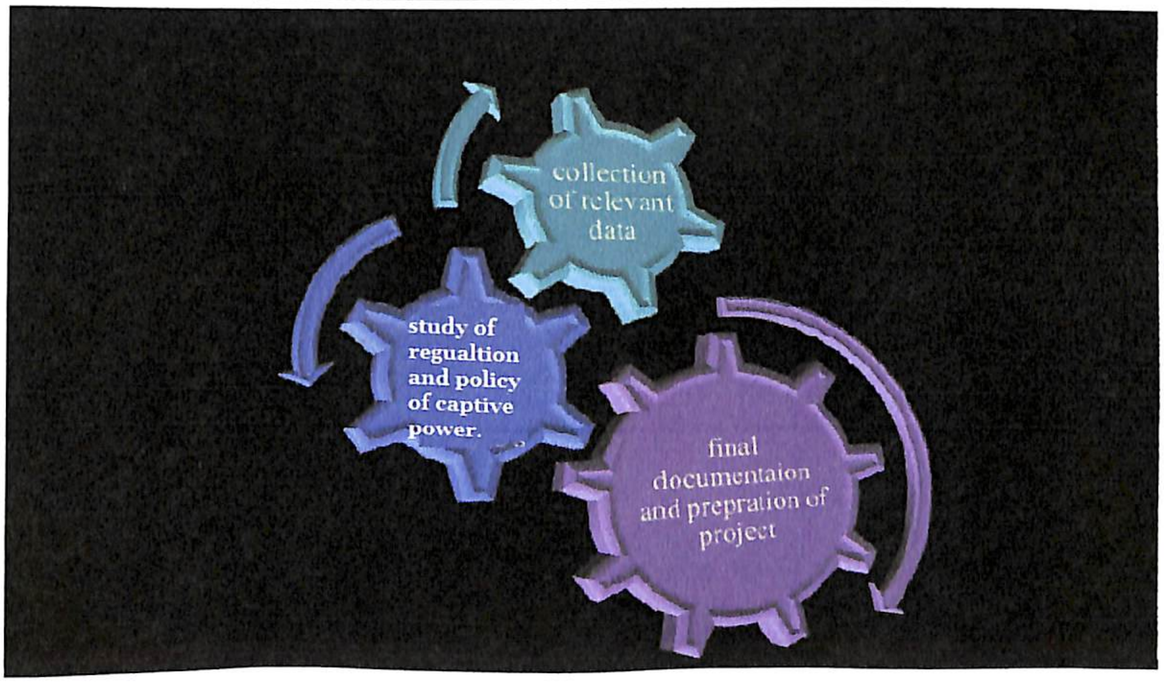
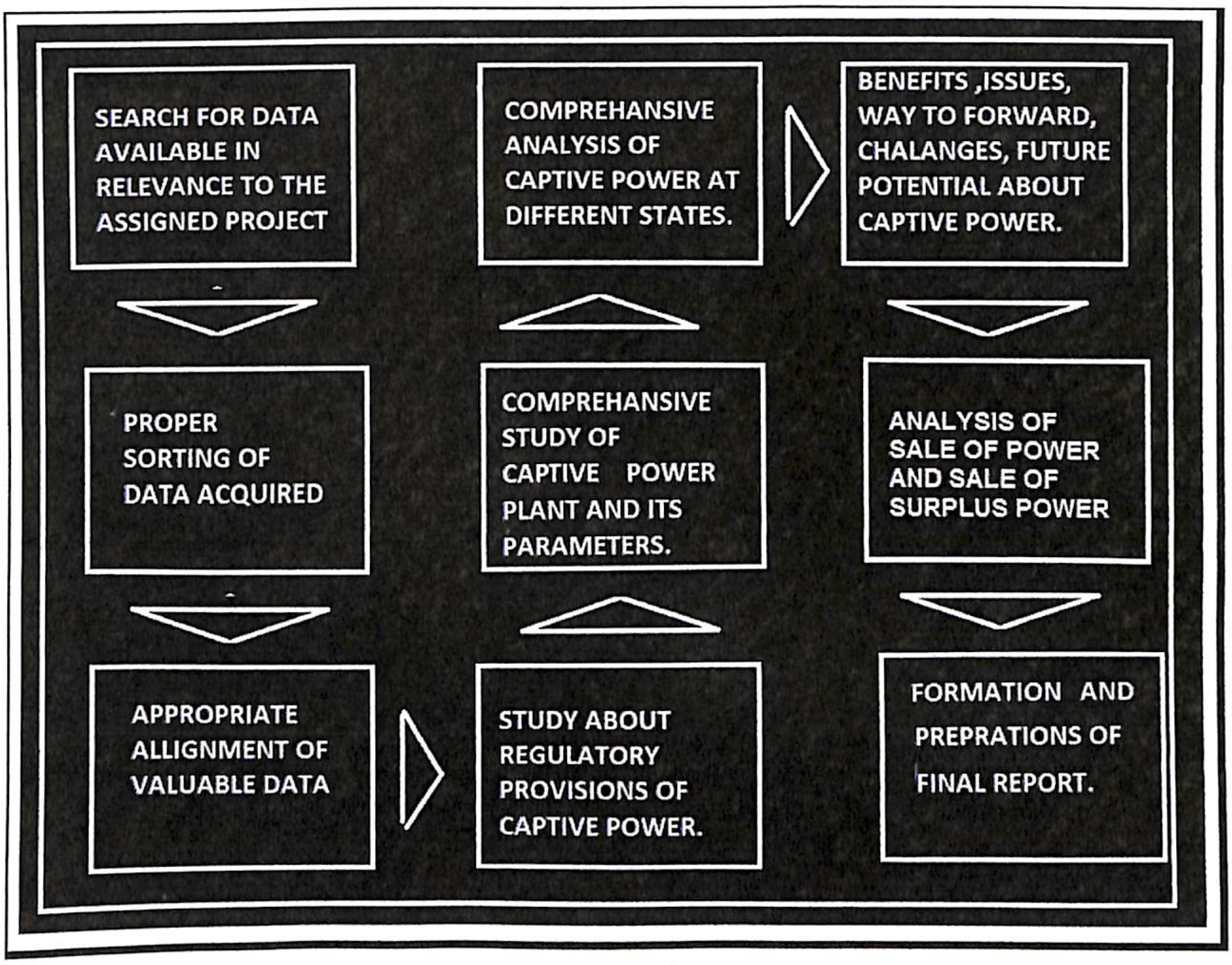


FIG 2: DETAIL STEPS OF RESEARCH DESIGN



❖ TYPES OF RESEARCH DESIGN

It is an **Exploratory Research** as well as **Descriptive Research** as it defines a problem more precisely, identify alternative courses of action. Secondly, various research papers are studied to identify a current scenario and conclude a role in a precise manner.

3.3 DATA ANAYSIS PROCEDURE:

After collecting the data from secondary sources, they have been arranged in tabular forms in a sequential and chronological fashion.

Ø STEPS TO BE UNDERTAKEN IN A STUDY

1. Understanding a Indian Power Sector
2. Understanding a current scenario of Captive power in Power Sector
3. Analyzing a various policy of different states in Power Sector focusing on Captive power.
4. Determining a future potential, issue, challenges, and way to forward in Captive power plant.
5. Analyzing the Sale of Power and Sale of Surplus power in Captive power plant.
6. Conclusion
7. Recommendations

Step 1: Understanding a Indian Power Sector

Understanding a Indian Power Sector, its current scenario and various laws made under a power sector in India which influences a decision making in a sector as well as helps to determine a future potential.

Step 2: Understanding a current scenario of Captive power in Power Sector

After understanding Indian Power Sector and various laws, a detailed study is done to understand a Captive power in India, analyzing a current scenario.

Step 3: Analysing a various policy of different states in Power Sector focusing on Captive power

Once a Captive Power in India is understood, various policy of different states are studied which can be applied in a Indian Power Sector for installation of Captive Power Plant..

Step 4: Determining a future potential, issue, challenges, and way to forward in Captive power plant

After determining a various applications, policy and knowledge about Captive power in Power Sector, then focus on issue, challenges, way to forward and future potential.

Step 5: Analyzing the Sale of Power and Sale of Surplus power in Captive power plant.

After determining a future potential, issue, challenges, and way to forward in Captive power plant, then focus on Sale of power and surplus power.

Step 6 Conclusion

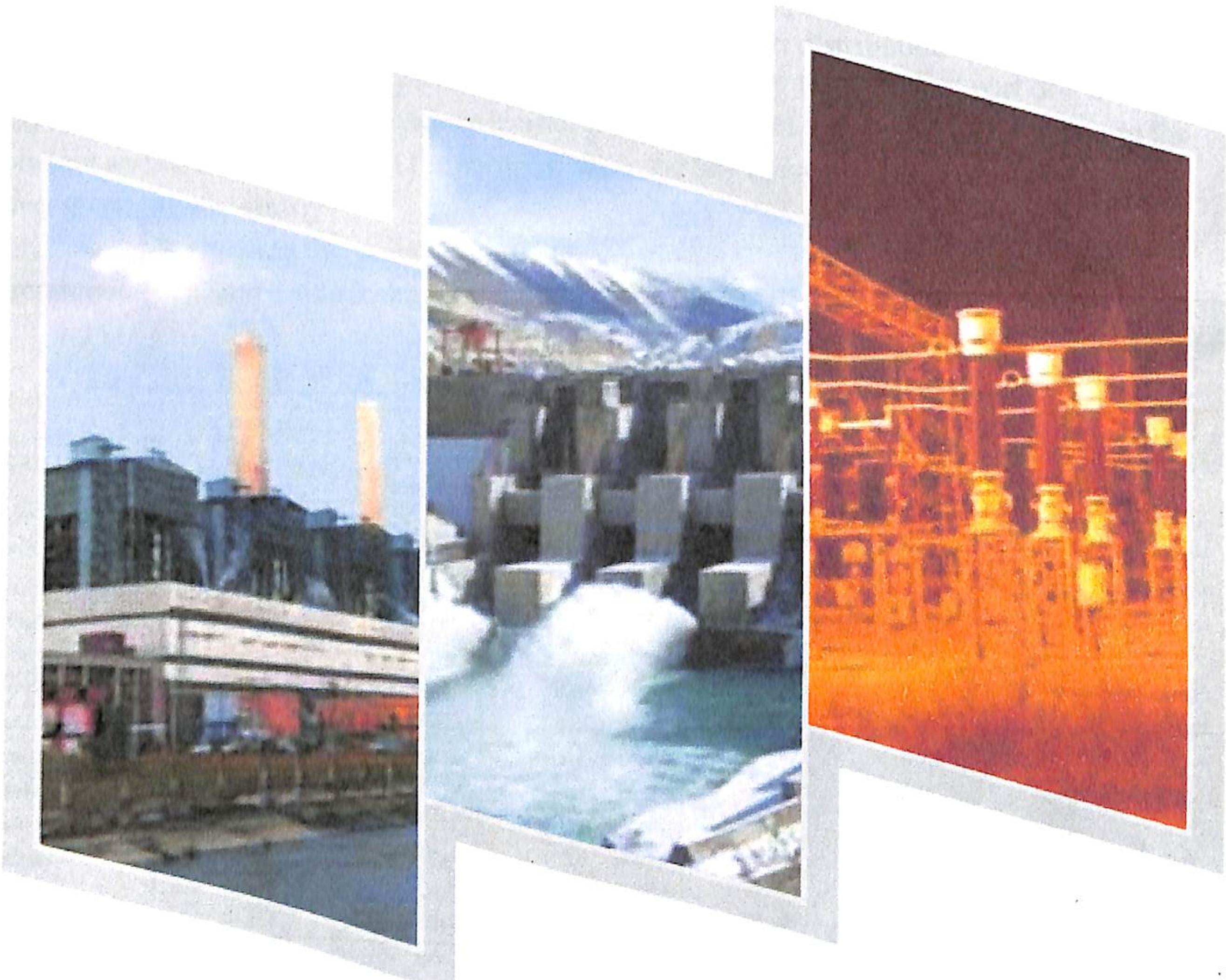
After analyzing a future potential of captive power, a conclusion will be drawn about a whole study using different diagrammatic representation and statistical tools defined earlier.

Step 7 Recommendations

After a study is done and all analysis are made, When a conclusion is derived, being a student I will try to give certain recommendations which country can think upon and may have a transformational approach to move towards a secure future.

CHAPTER 4: DATA FINDING & ANAYLYSIS

CHAPTER 4: DATA FINDING & ANAYLYSIS



4.1 POWER SCENARIO IN INDIA

4.1.1 CURRENT SCENARIO

Electricity forms the backbone of the countries. India's power sector is one of the more ignored sectors in the Indian economy. While there has been some investment and calls for increase in capacity, a third of Indian citizens, especially in the rural parts of the country remains without power, as does 6% of the urban population. All India capacity is 2, 81,006 MW up to 28.02.2015 The electric power sector comprising generation, transmission and distribution system is considered as the greatest machinery ever created. This machinery is an integral part of the national infrastructure and its performance is vital to the success of the country's economy, to the environment and health goals and to the security. Over the last five decades, the electric power in India has grown tremendously.

Table 1, 2 & Fig 3 showing the year-wise growth of installed capacity in India and growth of consumption in India and Table 3 showing the state wise growth of installed capacity in India.

TABLE1: YEAR-WISE GROWTH OF INSTALLED CAPACITY IN INDIA

Installed Capacity as on	Thermal (MW)				Nuclear (MW)	Renewable (MW)			Total (MW)	% Growth (on yearly basis)
	Coal	Gas	Diesel	Sub-Total Thermal		Hydel	Other Renewable	Sub-Total Renewable		
31-Dec-1947	756	-	98	854	-	508	-	508	1,362	-
31-Dec-1950	1,004	-	149	1,153	-	560	-	560	1,713	8.59%
31-Mar-1956	1,597	-	228	1,825	-	1,061	-	1,061	2,886	13.04%
31-Mar-1961	2,436	-	300	2,736	-	1,917	-	1,917	4,653	12.25%
31-Mar-1966	4,417	137	352	4,903	-	4,124	-	4,124	9,027	18.60%
31-Mar-1974	8,652	165	241	9,058	640	6,966	-	6,966	16,664	10.58%
31-Mar-1979	14,875	168	164	15,207	640	10,833	-	10,833	26,680	12.02%
31-Mar-1985	26,311	542	177	27,030	1,095	14,460	-	14,460	42,585	9.94%
31-Mar-1990	41,236	2,343	165	43,764	1,565	18,307	-	18,307	63,636	9.89%
31-Mar-1997	54,154	6,562	294	61,010	2,225	21,658	902	22,560	85,795	4.94%
31-Mar-2002	62,131	11,163	1,135	74,429	2,720	26,269	1,628	27,897	105,046	4.49%
31-Mar-2007	71,121	13,692	1,202	86,015	3,900	34,654	7,760	42,414	132,329	5.19%
31-Mar-2012	1,12,022	18,381	1,200	1,31,603	4,780	38,990	24,503	63,493	199,877	9.00%
31-Mar-2014	1,45,273	21,782	1,200	1,68,255	4,780	40,532	31,692	72,224	2,45,259	10.77%
31-Mar-2015[2]	1,64,636	23,062	1,200	188,898	5,780	41,267	@35,777	77,044	271,722	10.8%

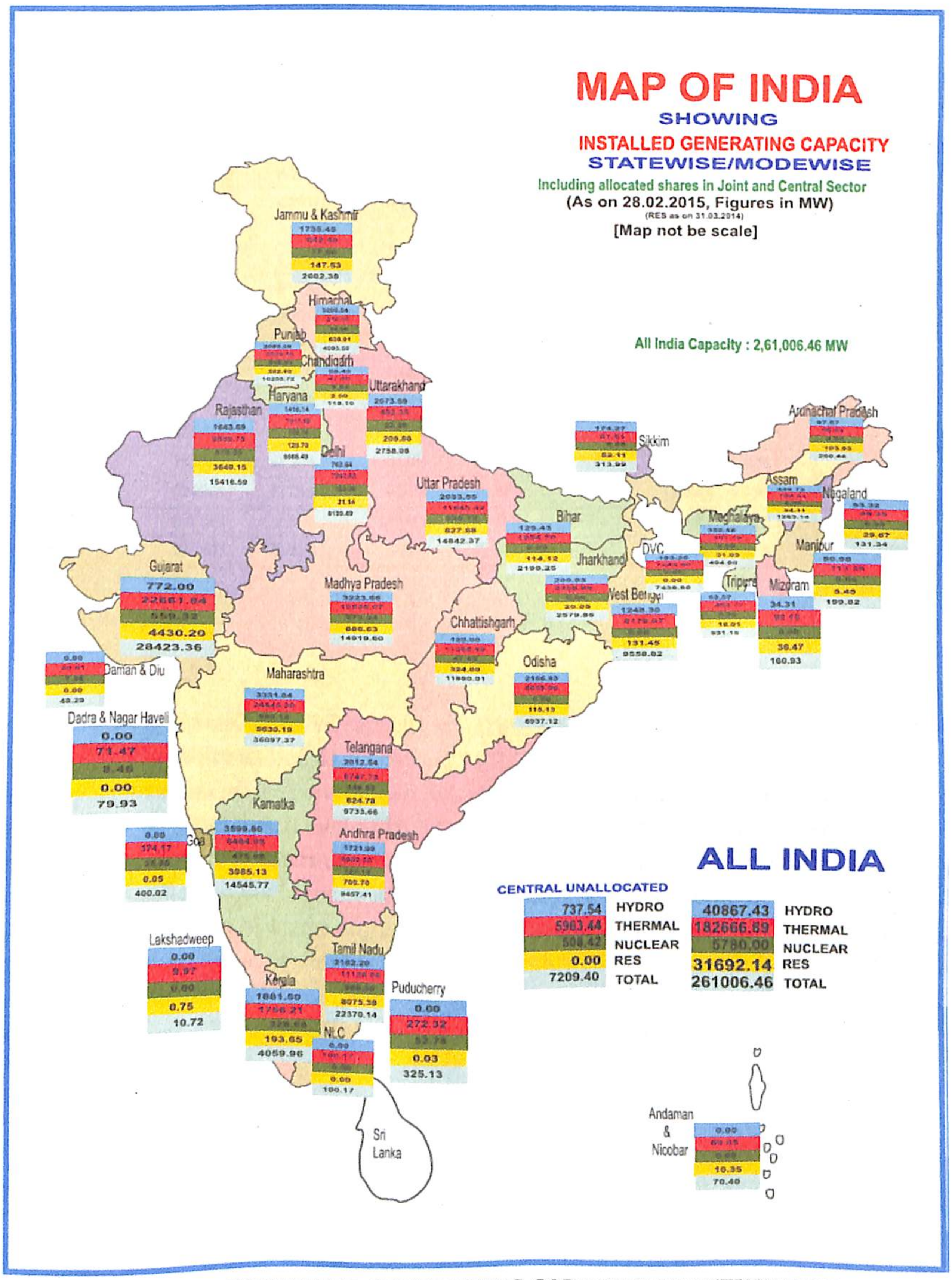


FIG 3 MAP OF INDIA INSTALLED GENERATING CAPACITY STATEWIDE/MODE WISE.

TABLE 2: YEAR-WISE GROWTH OF ELECTRICITY CONSUMPTION CAPACITY IN INDIA

Consumption as on	Total (in GWh)	% of Total						Per-Capita Generation (in kWh) [clarification needed]
		Domestic	Commercial	Industrial	Traction	Agriculture	Misc	
31-Dec-1947	4,182	10.11%	4.26%	70.78%	6.62%	2.99%	5.24%	16.3
31-Dec-1950	5,610	9.36%	5.51%	72.32%	5.49%	2.89%	4.44%	18.2
31-Mar-1956	10,150	9.20%	5.38%	74.03%	3.99%	3.11%	4.29%	30.9
31-Mar-1961	16,804	8.88%	5.05%	74.67%	2.70%	4.96%	3.75%	45.9
31-Mar-1966	30,455	7.73%	5.42%	74.19%	3.47%	6.21%	2.97%	73.9
31-Mar-1974	55,557	8.36%	5.38%	68.02%	2.76%	11.36%	4.13%	126.2
31-Mar-1979	84,005	9.02%	5.15%	64.81%	2.60%	14.32%	4.10%	171.6
31-Mar-1985	124,569	12.45%	5.57%	59.02%	2.31%	16.83%	3.83%	228.7
31-Mar-1990	195,098	15.16%	4.89%	51.45%	2.09%	22.58%	3.83%	329.2
31-Mar-1997	315,294	17.53%	5.56%	44.17%	2.09%	26.65%	4.01%	464.6
31-Mar-2002	374,670	21.27%	6.44%	42.57%	2.16%	21.80%	5.75%	671.9
31-Mar-2007	525,672	21.12%	7.65%	45.89%	2.05%	18.84%	4.45%	559.2
31-March-2012	785,194	22.00%	8.00%	45.00%	2.00%	18.00%	5.00%	883.6
31-March-2013	824,301	22.29%	8.83%	44.40%	1.71%	17.89%	4.88%	914.4
31-March-2014	881,562	22.95%	8.80%	43.17%	1.75%	18.19%	5.14%	957
31-March-2015	938,823	23.53%	8.77%	42.10%	1.79%	18.45%	5.37%	1010.0 Provisional

•As of 2015, total thermal installed capacity stood at 189.3 GW, while hydro and renewable energy installed capacity totaled 41.6 GW and 35.8 GW, respectively. At 5.8 GW, nuclear energy capacity had increased considerably which otherwise remained the same from 2010 - 14
•For the 12th Five-Year Plan, a total of 88.5 GW of power capacity addition is targeted; of which, 72.3 GW constitutes thermal power, 10.8GW hydro power and 5.3 GW nuclear power. By 2022, the installed power capacity in India is expected to reach 350 gigawatts (GW) from 243 GW in 2014, on the back of increasing industrialization and economic development. The total MARKET size of electrical machinery in India is anticipated to reach US$ 100 billion by 2022 from US$ 24 billion in 2013.

TABLE 3 : STATE -WISE GROWTH OF INSTALLED CAPACITY IN INDIA

	Thermal (in MW)					Renewable (in MW)				
State/Union Territory	Coal	Gas	Diesel	Sub-Total Thermal	Nuclear (in MW)	Hydel	Other Renewable	Sub-Total Renewable	Total (in MW)	% of Total
Maharastra	24,669.27	3,475.93	-	28,145.20	690.14	3,331.84	6,205.65	9,537.49	38,372.83	13.91%
Gujarat	16,010.27	6,806.09	-	22,816.36	559.32	772	4,802.40	5,574.40	28,950.08	10.49%
Madhya Pradesh	11,126.39	257.18	-	11,383.57	273.24	3,223.66	1,670.34	4,894.00	16,550.81	6.00%
Chhattisgarh	13,193.49	-	-	13,193.49	47.52	120	327.18	447.18	13,688.19	4.96%
Goa	326.17	48	-	374.17	25.8	-	0.05	0.05	400.02	0.14%
Dadra & Nagar Haveli	44.37	27.1	-	71.47	8.46	-	-	-	79.93	0.03%
Daman & Diu	36.71	4.2	-	40.91	7.38	-	-	-	48.29	0.02%
Central - Unallocated	*1,622.35*	*196.91*	-	*1,819.26*	*228.14*	-	-	-	*2,047.40*	*0.74%*
Western Region	***67,029.01***	***10,815.41***	**-**	***77,844.42***	***1,840.00***	***7,447.50***	***13,005.62***	***20,453.12***	***100,137.54***	***36.29%***
Rajasthan	9,400.72	825.03	-	10,225.75	573	1,719.30	4,710.50	6,429.80	17,228.55	6.24%
Uttar Pradesh	11,677.95	549.97	-	12,227.92	335.72	2,168.30	989.86	3,158.16	15,721.80	5.70%
Punjab	6,444.88	288.92	-	6,733.80	208.04	3,145.13	503.42	3,648.55	10,590.38	3.84%
Haryana	6,527.53	560.29	-	7,087.82	109.16	1,456.83	138.6	1,595.43	8,792.41	3.19%
Delhi	5,001.87	2,366.01	-	7,367.88	122.08	822.05	34.71	856.76	8,346.72	3.03%
Himachal Pradesh	152.02	61.88	-	213.9	34.08	3,421.51	728.91	4,150.42	4,398.40	1.59%
Uttarakhand	399.5	69.35	-	468.85	22.28	2,441.82	244.32	2,686.14	3,177.27	1.15%
Jammu & Kashmir	329.32	304.14	-	633.46	77	1,805.21	156.53	1,961.74	2,672.20	0.97%
Chandigarh	32.54	15.32	-	47.86	8.84	62.32	5.04	67.36	124.06	0.04%
Central - Unallocated	*977.19*	*290.35*	-	*1,267.54*	*129.8*	*754.3*	-	*754.3*	*2,151.64*	*0.78%*
Northern Region	***40.943.50***	***5,331.26***	***12.99***	***46,274.76***	***1,620.00***	***17,796.77***	***7,511.89***	***25,308.66***	***73,203.42***	***26.53%***
Tamil Nadu	10,075.10	1026.3	411.66	11,513.06	986.5	2,182.20	8,423.15	10,605.35	23,104.91	8.37%
Karnataka	6,408.46	-	234.42	6,642.88	475.86	3,599.80	4552.48	8,152.28	15,271.02	5.53%
Andhra Pradesh	5,849.21	1,672.65	16.97	7,538.83	127.16	1,721.99	2,002.65	3,724.64	11,390.64	4.13%
Telangana	5,598.47	1,697.75	19.83	7,316.05	148.62	2012.54	62.75	2,075.29	9,539.96	3.46%
Kerala	1,038.69	533.58	234.6	1,806.87	228.6	1881.5	204.05	2,085.55	4,121.02	1.49%
Puducherry	249.32	32.5	-	281.82	52.78	-	0.03	0.03	334.63	0.12%
Central - NLC	100.17	-	-	100.17	-	-	-	-	100.17	0.04%
Central - Unallocated	*1,523.08*	-	-	*1,523.08*	*300.48*	-	-	-	*1,823.56*	*0.66%*
Southern Region	***30,842.50***	***4,962.78***	***917.48***	***36,722.76***	***2,320.00***	***11,398.03***	***15,245.11***	***26,643.14***	***65,685.90***	***23.81%***
West Bengal	8,083.83	100	-	8,183.83	-	1,248.30	131.45	1,379.75	9,563.84	3.47%
Odisha	6,753.04	-	-	6,753.04	-	2,166.93	116.55	2,283.48	9,036.52	3.28%
DVC	*7,160.66*	*90*	-	*7,250.66*	-	*193.26*	-	*193.26*	*7,443.92*	*2.70%*
Bihar	2,516.24	-	-	2,516.24	-	129.43	114.12	243.55	2,759.79	1.00%
Jharkhand	2,404.93	-	-	2,404.93	-	200.93	20.05	220.98	2,625.91	0.95%
Sikkim	92.1	-	-	92.1	-	174.27	52.11	226.38	318.48	0.12%
Central - Unallocated	*1,572.07*	-	-	*1,572.07*	-	-	-	-	*1,572.07*	*0.57%*
Eastern Region	***28,582.87***	***190***	**-**	***28,772.87***	**-**	***4,113.12***	***434.54***	***4,547.66***	***33,320.53***	***12.08%***
Assam	187	718.62	-	905.62	-	429.72	34.11	463.83	1,369.45	0.50%
Tripura	18.7	538.82	-	557.52	-	62.37	21.01	83.38	640.9	0.23%
Meghalaya	17.7	105.14	-	122.84	-	356.58	31.03	387.61	510.45	0.19%
Arunachal Pradesh	12.35	43.06	-	55.41	-	97.57	104.64	202.21	257.62	0.09%
Manipur	15.7	67.98	36	119.68	-	80.98	5.45	86.43	206.11	0.07%
Nagaland	10.7	46.35	-	57.05	-	53.32	29.67	82.99	140.04	0.05%
Mizoram	10.35	38.29	-	48.64	-	34.31	36.47	70.78	119.42	0.04%
Central - Unallocated	*37.5*	*104.44*	-	*141.94*	-	*127.15*	-	*127.15*	*269.09*	*0.10%*
North-Eastern Region	***310***	***1,662.70***	***36***	***2,008.70***	**-**	***1,242.00***	***262.38***	***1,504.38***	***3,513.08***	***1.27%***
Andaman & Nicobar	-	-	40.05	40.05	-	-	10.35	10.35	50.4	0.02%
Lakshadweep	-	-	-	-	-	-	0.75	0.75	0.75	0.00%

Electricity generation in India is mainly thermal-based with some hydro and a few nuclear power stations - 70% thermal, 25% hydro, 2.8% nuclear and 2.2% grid-connected renewable represented in Fig 4 (represented in %) AND Fig 5 (represented in GW).

FIG 4

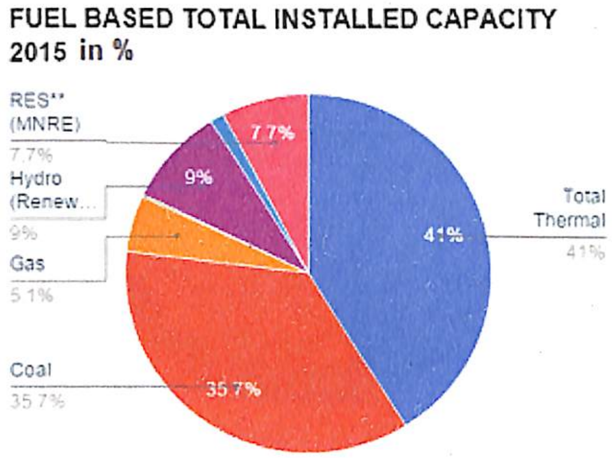
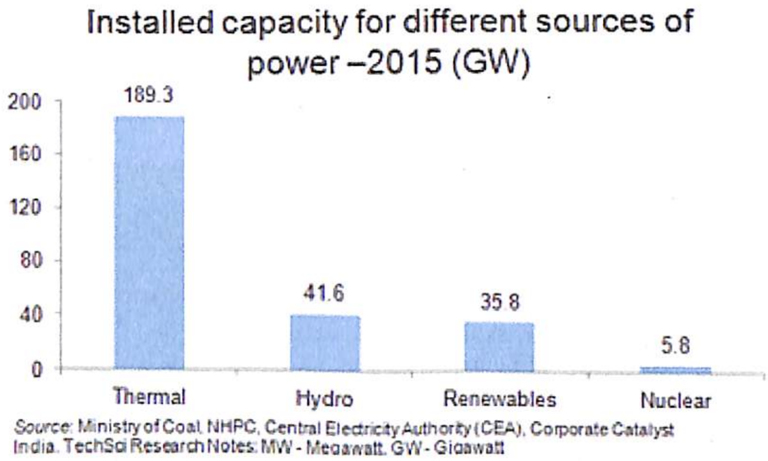


FIG 5



- Renewable Energy Sources (RES) include SHP, BG, BP, U&I and Wind Energy
-SHP= Small Hydro Project
-BG= Biomass Gasifier, BP= Biomass Power,
- U & I=Urban & Industrial Waste Power
- RES=Renewable Energy Sources

Sector based installed capacity is main sectors are State having 34.6%, Private contain 38.8%, Central consist 26.6% fig 6

FIG 6

DIFFERENT SECTOR BASED INSTALLED CAPACITY IN %

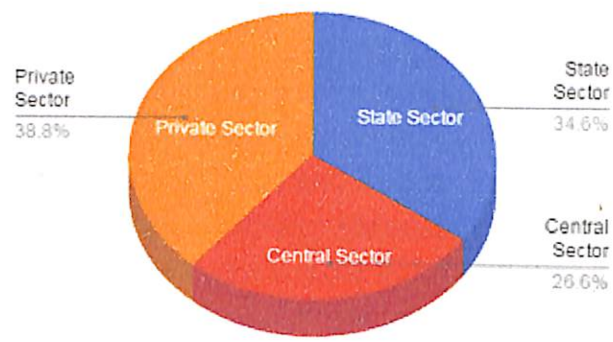


TABLE 4: INSTALLED CAPACITY BASED ON FUEL AND SECTOR FROM 2012 TO 2015

Year	Fuel / Sector	Thermal		Hydro	Nuclear	Total
		Coal	Gas			
2012-13	Central	4660	363.3	374	0	5397
	State	3200	711	57	0	3968
	Private	10805	382.5	70	0	11258
	Total	**18665**	**1456.8**	**501**	**0**	**20622.8**
2013-14	Central	1660	0	914.1	0	2574.1
	State	2450	872	45	0	3367
	Private	10985	800	99	0	11884
	Total	**15095**	**1672**	**1058.1**	**0**	**17825.1**
2014-15*	Central	600	363.3	336.01	1000	2299.31
	State	2250	426.1	0	0	2676.1
	Private	7135	400	0	0	7535
	Total	**9985**	**1189.4**	**336.01**	**1000**	**12510.4**
12th Plan*	**Central**	6920	726.6	1624.11	1000	10270.7
	State	7900	2009.1	102	0	10011.1
	Private	28925	1582.5	169	0	30676.5
	Total	**43745**	**4318.2**	**1895.11**	**1000**	**50958.3**

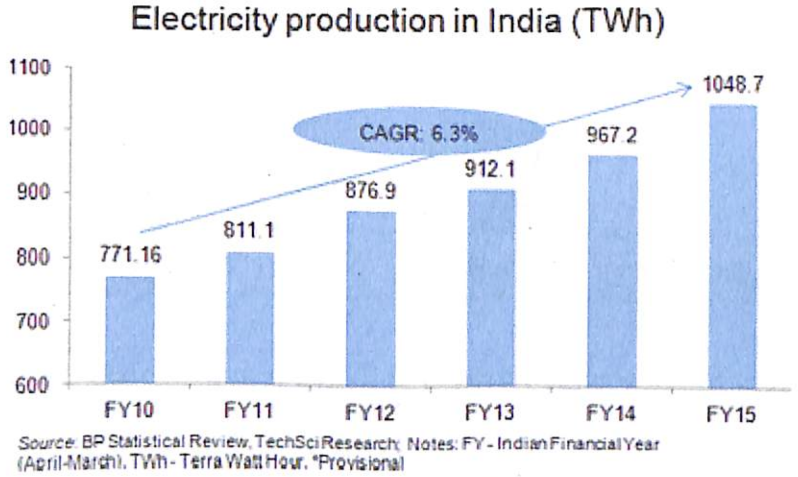
up to 15.01.2015

List of Projects Commissioned (till 15.01.2015)

Page 1

The utility electricity sector in India had an installed capacity of 278.733 GW as of 30 September 2015.Renewable Power plants constituted 28% of total installed capacity and Non-Renewable Power Plants constituted the remaining 72%. The gross electricity generated by utilities is 1,106 TWh (1,106,000 GWh) and 166 TWh by captive power plants during the 2014–15 fiscal. The gross electricity generation includes auxiliary power consumption of power generation plants. India became the world's third largest producer of electricity in the year 2013 with 4.8% global share in electricity generation surpassing Japan and Russia.
During the year 2014-15, the per capita electricity generation in India was 1,010 kWh with total electricity consumption (utilities and non-utilities) of 938.823 billion or 746 kWh per capita electricity consumption. Electric energy consumption in agriculture was recorded highest (18.45%) in 2014-15 among all countries. The per capita electricity consumption is lower compared to many countries despite cheaper electricity tariff in India. Power Generation has grown rapidly over the years
•Electricity production in India stood at 1,048.7 TWh in FY15, a 8.4 per cent growth over the previous fiscal in fig 7

FIG 7



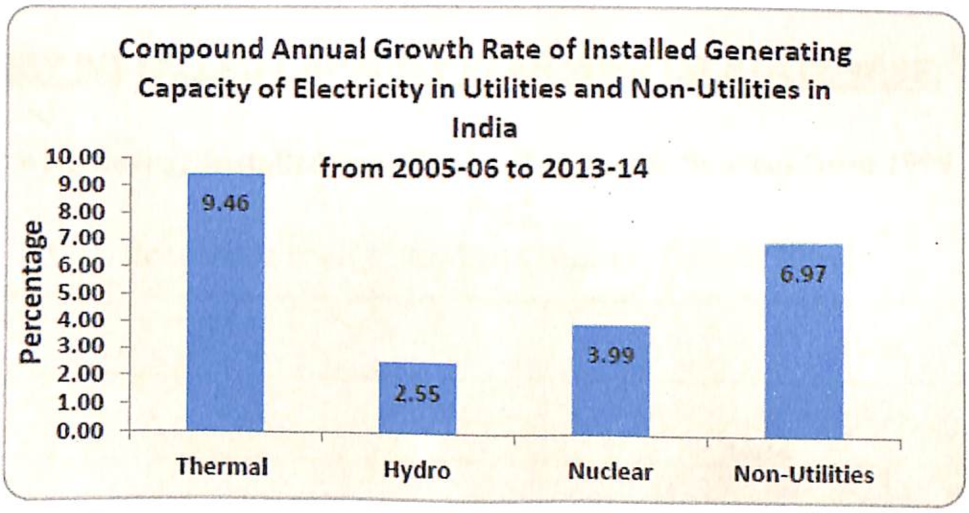
•Over FY10–15, electricity production expanded at a CAGR of 6.3 % refer fig 7.
•The Planning Commission's 12th Plan projects that total domestic energy production would reach 669.6 million tonnes of OILequivalent (MTOE) by 2016–17 and 844 MTOE by 2021–22

The total installed capacity for electricity generation in the country has increased from 145755 MW as on 31.03.2006 to 284,634 MW as on 31.03.2014, registering a compound annual growth rate (CAGR) of 7.72% .

- There has been an increase in generating capacity of 17990 MW over the last one year, the annual increase being 6.75%.

- The highest rate of annual growth (11.66%) from 2012-13 to 2013-14 in installed capacity was for Thermal power followed by Hydro Power (2.63%).
- The total Installed capacity of power utilities in the country increased from 124,287 MW in 31.3.2006 to 245,259 MW as on 31.3.2014, with a CAGR of 7.84 % over the period.
- At the end of March 2014, thermal power plants accounted for an overwhelming 70.25% of the total installed capacity in the country, with an installed capacity of 199,947 MW. The share of Nuclear energy was only 1.68% (4.78 GW).
- Hydro power plants come next with an installed capacity of 40,531 MW, accounting for 14.24% of the total installed Capacity.
- Non-utilities accounted for 13.83% (39,375MW) of the total installed generation capacity.
- The highest CAGR (9.46%) fig 8 was in case of Thermal utilities followed by Nuclear

FIG 8



- The geographical distribution of Installed generating capacity of electricity as on 31.03.14 indicates that Western Region (both central and state sector) accounted for the highest share (36.18%) followed by Northern Region (26.28%), Southern Region (24.06%), Eastern Region (12.29%) and North Eastern Region (1.19%).
- Region wise growth in the installed capacity during 2013-14 reveals that Western Region registered the highest annual growth of about 15.94%, followed by Northern Region (7.65%) and Eastern Region (7.03%).
- Among the States in the Western Region that accounted for the highest growth of 15.94%, Chhattisgarh registered the highest (66.24%) followed by Madhya Pradesh (50.17%).
- Among all the states Sikkim registered highest annual growth (164.59%) growth in the installed capacity followed by Chhattisgarh (66.24%) and Madhya Pradesh (50.17%).

Depending on the type of fuel used, the power generating stations as well as the types of power generation are classified. Therefore the 3 major classifications for power production in reasonably large scale are:-

1. Thermal power generation.
2. Nuclear power generation.
3. Hydro-electric power generation.

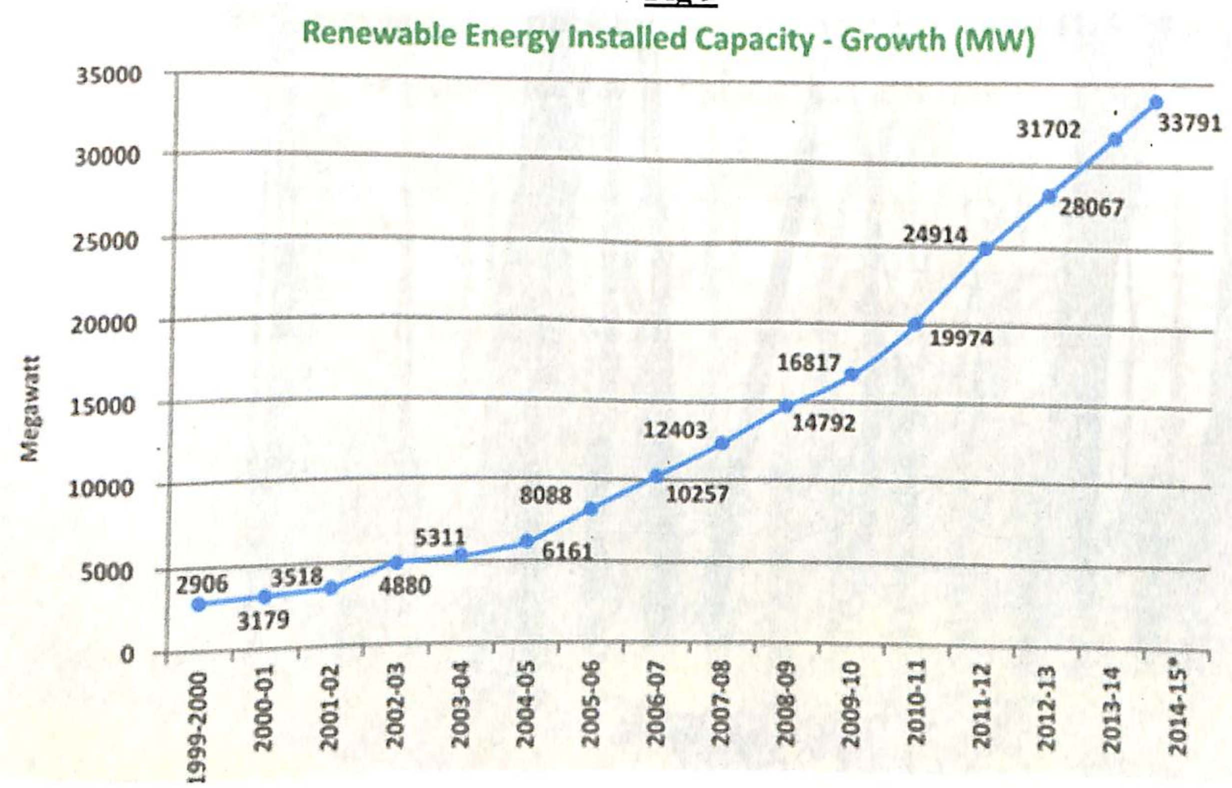
Apart from these major types of power generations, we can resort to small scale generation techniques as well, to serve the discrete demands. These are often referred to as the alternative methods of power generation and can be classified as:-

1) Solar power generation. (Making use of the available solar energy)
2) Wind power generation
3) Diesel power generation
4) Geo-thermal power generation. (Energy available in the Earth's crust)
5) Tidal power generation.

4.1.2 ENERGY INSTALLED CAPACITY YEAR WISE OR STATE WISE.

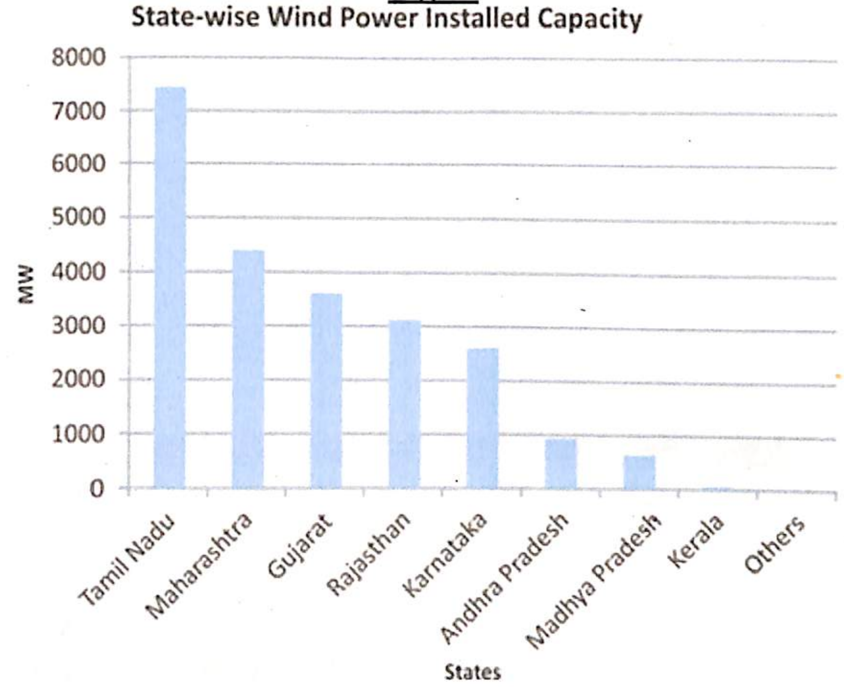
- **Year wise Energy installed capacity by Renewable Sources from 1999 to 2015 fig 9.**

Fig 9



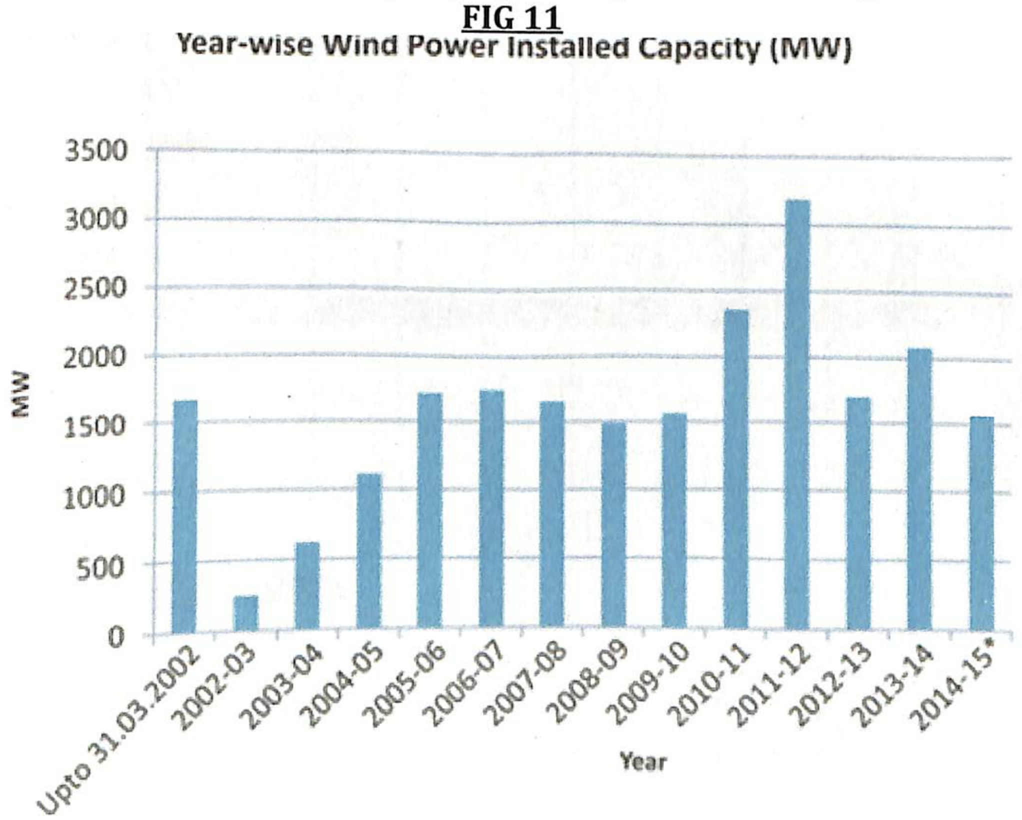
- State wise Energy installed capacity by Wind power Sources fig 10.

Fig 10



- Year wise Energy installed capacity by Wind power Sources fig 11.

FIG 11

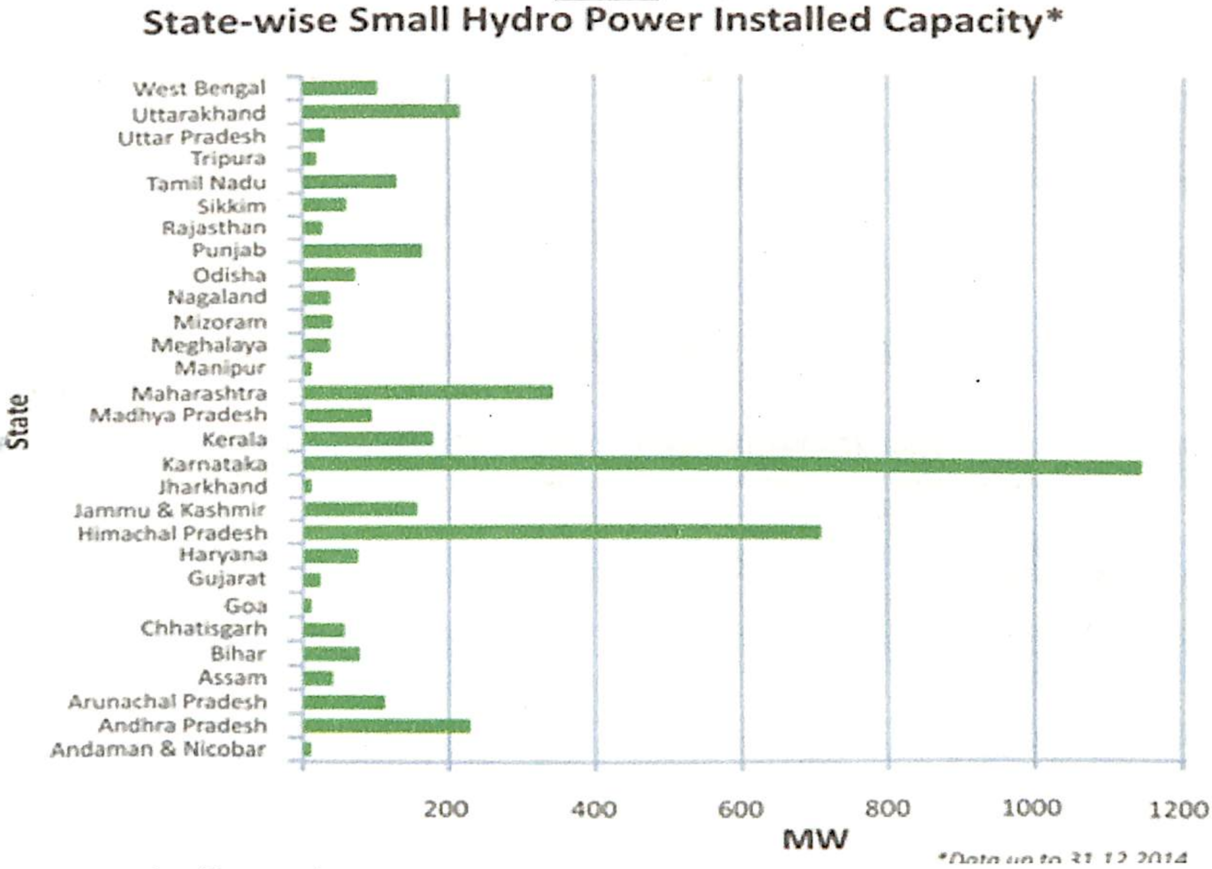


➤ **State wise Energy installed capacity by solar power Sources fig 12.**

Fig 12

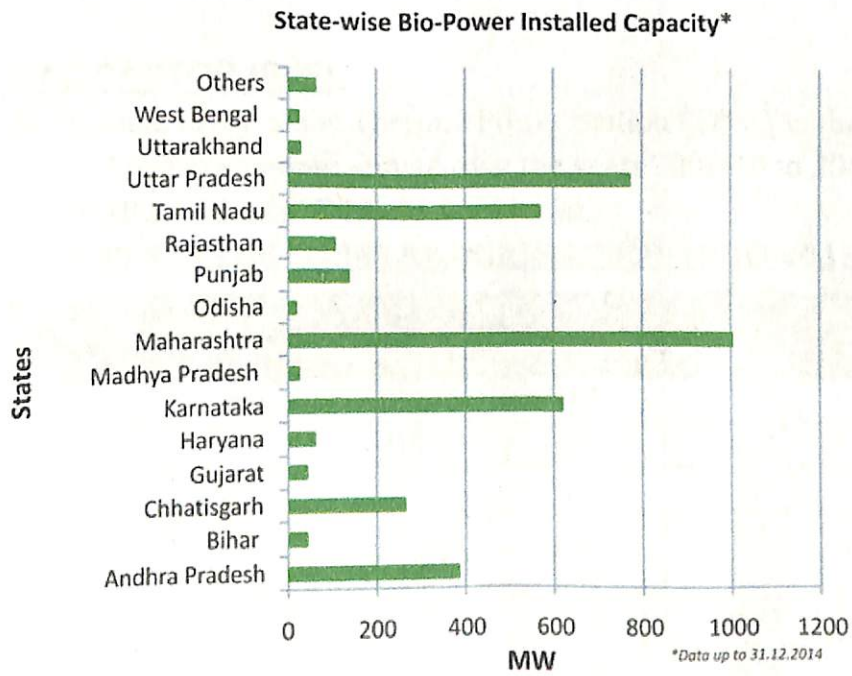
➤ **State wise Energy installed capacity by Small Hydro power Sources fig 13.**

FIG 13



- **State wise Energy installed capacity by Bio power Sources fig 14.**

FIG 14



4.1.3 GENERATION PERFORMANCE:-

I. ELECTRICITY GENERATION PERFORMANCE

The electricity generation target for the year 2015-2016 was fixed as 1137.5 Billion Unit (BU). i.e. growth of around 8.47% over actual generation of 1048.673 for the previous year (2014-2015). The generation during (2014-15) was 1048.673 BU as compared to 967.150 BU generated during April- March 2014, representing a growth of about 8.43%.

Programme, actual achievement and growth in electricity generation in the country during 2009-10 to 2015-16 (Table 5) :-

TABLE 5: ACTUAL ACHIEVEMENT AND GROWTH IN ELECTRICITY DURING 2009-10 TO 2015-16

Year	Target	Achievement	% of target	% of growth
2009-10	789.511	771.551	97.73	6.6
2010-11	830.757	811.143	97.64	5.56
2011-12	855	876.887	102.56	8.11
2012-13	930	912.056	98.07	4.01
2013-14	975	967.15	99.19	6.04
2014-15	1023	1048.673	102.51	8.43
2015-16* (Upto September 2015)	565.842	555.448	98.16	4.42
* Provisional				

The electricity generation target for the year 2014-15 has been fixed at 1137.5 BU comprising of 966.700 BU thermal; 128.000 BU hydro; 38.000 nuclear; and 4.800 BU import from Bhutan.

II. PLANT LOAD FACTOR (PLF):

Notwithstanding the fact that many of the Thermal Power Station (TPSs) in the country are vary old, the plant load factor has shown improvement over the years 2009-10 to 2012-13.The PLF in the country during 2009-10 to 2015-16(Table 6) is as under:

TABLE 6: PLF IN THE COUNTRY DURING 2009-10 TO 2015-16

Year	Target %	Actual %	Sector-wise Actual		
			Central	State	Private
2009-10	77.2	77.5	85.5	70.9	83.9
2010-11	72.1	75.1	85.1	66.7	80.7
2011-12	68.7	73.3	82.1	68	69.5
2012-13	70	69.9	79.2	65.6	64.1
2013-14	69.6	65.6	76.1	59.1	62.1
2014-15	65.52	64.46	73.96	59.83	60.58
2015-16 (Upto September 2015)	66.32	60.85	72.33	54.34	57.65

III. POWER SUPPLY POSITION

The power supply position in the country during 2009-10 to 2015-16 (Table 7).

TABLE 7: POWER SUPPLY POSITION DURING 2009-10 TO 2015-16

	Energy				Peak			
	Requirement	Availability	Surplus(+)/Defícts(-)		Peak Demand	Peak Met	Surplus(+) / Defícts(-)	
Year	(MU)	(MU)	(MU)	(%)	(MW)	(MW)	(MW)	(%)
2009-10	8,30,594	7,46,644	-83,950	-10.1	1,19,166	1,04,009	-15,157	-12.7
2010-11	8,61,591	7,88,355	-73,236	-8.5	1,22,287	1,10,256	-12,031	-9.8
2011-12	9,37,199	8,57,886	-79,313	-8.5	1,30,006	1,16,191	-13,815	-10.6
2012-13	9,95,557	9,08,652	-86,905	-8.7	1,35,453	1,23,294	-12,159	-9
2013-14	10,02,257	9,59,829	-42,428	-4.2	1,35,918	1,29,815	-6,103	-4.5
2014-15	10,68,923	10,30,785	-38,138	-3.6	1,48,166	1,41,160	-7,006	-4.7
2015-16*	5,61,876	5,48,521	-13,355	-2.4	1,50,728	1,46,124	-4,604	-3.1

4.1.4 OVERVIEW OF GENERATION:

The Overall generation in the country has been increased from 967.150 BU during 2013-14 to 1048.673 BU during the year 2014-15. The Category wise generation performance as follows:-

1. Thermal Increased by 10.83 %
2. Hydro Reduced by 4.16 %
3. Nuclear Increased by 5.47 %
4. Bhutan Import Reduced by 10.54 %

Overall Growth rate recorded by 8.43 %

The annual growth in power generation during recent years is as under:

TABLE 8 :ANNUAL GROWTH IN POWER GENERATION

Year	Growth in Achievement(%)
2008-09	2.7
2009-10	6.6
2010-11	5.56
2011-12	8.11
2012-13	4.01
2013-14	6.04
2014-15	8.43

4.1.5 OVERVIEW OF TRANSMISSION :

Power Grid Corporation of India Limited (POWERGRID, the 'Central Transmission Utility (CTU)' of the country and a 'Navratna' Company operating under Ministry of Power, is engaged in power transmission business with the responsibility for planning, implementation, operation and maintenance of inter-State transmission system and operation of National & Regional Power Grids. POWERGRID is a listed Company, with 57.90% holding of Government of India and balance by Institutional Investors & public.

POWERGRID has been implementing various transmission projects for generation capacity addition under central sector, Ultra Mega Power Projects (UMPPs), Independent Power Producers (IPPs) and other projects. As on December 31, 2014, the Company owns & operates transmission network of about 1,13,587 ckm of transmission lines and 188 nos. of EHVAC & HVDC substations with transformation capacity of about 2,19,579 MVA. The Company continues to wheel about 50% of total power generated in the Country through its transmission network at an availability of over 99% consistently.

The company exhibited an impressive financial performance during FY 2013-14, earning a net profit of Rs. 4,497 Crore with Turnover of Rs. 15,721 Crore and Gross Asset Base of Rs. 96,504 Crore.Power System Operation Corporation Limited (POSOCO), a 100% subsidiary of the Company, has been successfully managing the National and Regional Grids through deployment of latest technology. Company's strong transmission network and modernised RLDCs have facilitated about 78.38 billion units (BUs) of inter-regional energy transfer across the Country during FY 2013-14 through execution of Short Term Open Access (STOA).

Integration of Renewable Energy Resources with conventional sources is a top priority worldwide and special attention is being given in our country to harness the Green Energy. CERC has provided a framework for trading in Green Certificates (Renewable Energy Certificates or RECs) and National Load Despatch Centre (NDLC) of POSOCO has been designated as the Central agency for this purpose.

Nationwide synchronous power grid, interconnecting all the five regional grids, has been established with the commissioning of 765kV S/c Raichur – Sholapur line on December 31, 2013. As on December 31, 2014, National Grid with inter-regional power transfer capacity of about 46,450 MW has been established. The inter-regional power transfer capacity is envisaged to be augmented to about 72,250MW by the end of the XII Plan (2016-17).

11 nos. of High Capacity Power Transmission Corridors (HCPTCs) have been finalized to meet bulk power evacuation requirement of various Independent Power Producers (IPPs) mainly coming up in resource rich and coastal States such as Chhattisgarh, Odisha, Madhya Pradesh, Sikkim, Jharkhand, Tamil Nadu and Andhra Pradesh at an estimated cost of about Rs. 75,000 Crore (POWERGRID's scope: about Rs. 66,000 Crore). Implementation of these corridors has been taken up in a phased manner matching with generation projects.

4.1.6 OVERVIEW OF DISTRIBUTION SECTOR:-

Distribution is the most important link in the entire power sector value chain. As the only interface between utilities and consumers, it is the cash register for the entire sector. Under the Indian Constitution, power is a Concurrent subject and the responsibility for distribution and supply of power to rural and urban consumers rests with the states. Government of India provides assistance to states through various Central Sector / centrally sponsored schemes for improving the distribution sector.

- **Integrated Power Development Scheme (IPDS)**

Scheme approved on 20.11.2014 with a total outlay of Rs 32,612 crore which includes a budgetary support of Rs 25,354 crore from Govt. of India. The objectives of scheme are:
a) Strengthening of sub-transmission and distribution networks in the urban areas;
Metering of distribution transformers / feeders / consumers in the urban area.
IT enablement of distribution sector and strengthening of distribution network
The component of IT enablement of distribution sector and strengthening of distribution network approved in June, 2013 in the form of RAPDRP for 12th and 13th Plans got subsumed in this scheme and approved scheme outlay of Rs 44,011 crore including a budgetary support of Rs 22,727 crore carried over to the new scheme of IPDS.

- **Deendayal Upadhyaya Gram Jyoti Yojana (DDUGJY)**

Scheme approved on 20.11.2014 with a total outlay of Rs 44,033 crore which includes a budgetary support of Rs 33,453 crore from Govt. of India. The objectives of scheme are:

- Separation of agriculture and non-agriculture feeders
- Strengthening of sub-transmission and distribution networks in the rural areas;
- Metering of distribution transformers / feeders / consumers in the rural area.
- Rural Electrification

The component of Rural Electrification approved in August, 2013 in the form of RGGVY for 12th and 13th Plans got subsumed in this scheme and approved scheme cost of Rs 39275 crore including a budgetary support of Rs 35447crore carried over to the new scheme of DDUGJY.

- **National Electricity Fund (NEF)**

To promote investment in the distribution sector, GoI has set up National Electricity Fund (Interest Subsidy Scheme) in March 2012 to provide interest subsidy on loans disbursed to the Distribution Companies (DISCOMS) – both in public and private sector, to improve the distribution network for areas not covered by RGGVY and R-APDRP project areas. The preconditions for eligibility are linked to certain reform measures taken by the States and the amount of interest subsidy is linked to the progress achieved in reforms linked parameters.

- **Financial Restructuring Scheme**

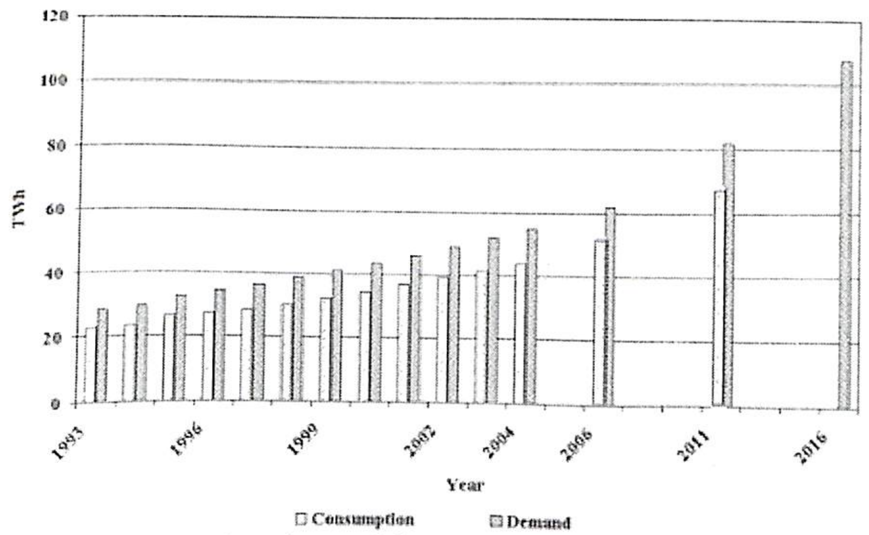
GoI has notified the scheme for Financial Restructuring of State Distribution Companies (Discoms) in October 2012 for achieving their financial turnaround by restructuring their short term liabilities with support through a Transitional Finance Mechanism from Central Govt.

4.1.7 DEMAND SUPPLY SCENARIO

On the demand side, India is considered to be the fifth largest consumer of power in the world accounting for 3.4% of global energy consumption. Due to India's economic rise and population growth, the demand for power has grown at an average of 3.6% over the past 30 years. The electricity consumption increased from 411,887 MU during 2005-06 to 911,209 MU during 2012-13, showing a cumulative average growth rate of 11 percent and upto 80 Twh(Fig 15).

Fig 15

Electricity Consumption and Demand



Due to this fast growing demand for electricity, the generation capacity, though large, has not been sufficient to meet the demand, resulting insubstantial shortages. During 2012-2013, load requirement was 998,114 Million Units (MU) against availability of 911,209 MU, which implied an energy shortage of 8.7%. During peak loads, the demand was for 135 GW against availability of 123 GW, leading to a peak shortage of 9.0% (Central Electricity Authority, Ministry of Power).But still the per capita consumption is low (879 KWh) as compared to other developing countries.

India is divided into five regions and hence has five electricity grids, namely Northern grid, Eastern grid, Western grid, Southern grid and North eastern grid. Except the Southern grid, all of them are interconnected.

Also, following the recommendations of India Smart Grid Task Force, smart grid pilot projects have been initiated in 14 states with a view to mitigate frequent power failures and voltage problems faced by the industrial groups. This modern electricity distribution network would address issues related to energy theft and trace malpractices, besides making the billing system more transparent and effective. The automatic fault finding & rectification and advanced metering infrastructure are few of its others features that would enable this network to drastically resolve industrial power woes

4.1.8 REASONS OF POWER SHORTAGES

Despite impressive growth in power generation and huge investment in the power sector, power shortage still continues in our country due to:-

(1) High Aggregate Technical and Commercial Losses (AT& C Losses)

AT&C loss captures technical as well as commercial losses in the network. High technical losses in the system are primarily due to inadequate investment on transmission and distribution in comparison to the generation, too many stages of transmission, overloading of system elements like transformers and conductors, absence of up-gradation of old lines and equipments, etc.The commercial losses are mainly caused by theft & pilferages; defective meters, errors in meter reading and in estimating unmetered supply of energy, absence of energy accounting and auditing, etc. The Eastern region suffered the highest AT&C losses in 2010-2011. It was recorded at 38.24%, which when compared to the lowest losses, i.e. 19.26% in the southern region.(Till 2010-11 T&D loss -23.97%,AT&C loss-26.15%-all India) .

(2) Poor Financial Health of DISCOMs
The financial health of the DISCOMs is extremely poor mainly because the pricing of power is far below the average cost of supply particularly for the agricultural consumers.

(3) Shortage of Fuel
There is a finite reserve of coal in India. Due to poor management and lack of proper infrastructure, the country isn't producing enough to feed its power plants. This can be directly attributed to the Ministry of Environment and Forest"s green activism. The long running tussle between the Ministry of Coal and Ministry of Environment and Forests over **„Go, No Go" classification** is only partially resolved and hence continues to pose a problem for the Ministry of Coal. The permission to divert forest areas for coal is not given for areas classified as „No-Go", leaving few virgin coal blocks to be capitalized by public sector companies like Coal India Ltd (CIL), Bharat Coking Coal Ltd., etc. Rail transportation of coal is another bottleneck in the sector. Inadequate placement of rakes delays the delivery of fuel to the various generation sites, leading to piling of fuel at company's various mines. Besides there is state level management problem also that aggravates the issue

(4) Low Load Factor
As per the sector wise plant load factor, the State sector is the least efficient. However, the private sector utilities and the Central utilities have managed to achieve competent efficiency rates. With such problems, a clear shortage in supply and the heavy demand on the national grids and public power facilities, India has experienced two major power cuts in the last few years; apart from the many smaller cuts experienced by all parts of the country at any given time.

(5) **Transmission Line**
Also Congestion in Transmission line corridor, Right of Way issues, improper R&M various T/Ls & S/Ss are the major problems for the evacuation of the available generated power to meet

the growing demand in the present growing economy condition.

4.2 CAPTIVE POWER PLANT

4.2.1 ABOUT CAPTIVE POWER PLANT

A captive power plant is a facility that is dedicated to providing a localized source of power to an energy user. These are typically industrial facilities or large offices. The plants may operate in grid parallel mode with the ability to export surplus power to the local electricity distribution network. A captive unit is a business unit of a company functioning offshore as an entity of its own while retaining the work and close operational tie ups within the parent company. The central (federal) government, state government, or private investors own the generation utilities. On the other hand, industries principally commission the CPPs. Various state level and central level acts defines CPPs in a variety of ways. Captive Power Plant (CPP) means

- The power plant set up / proposed to be set up by an industry / institution / a person for its / his own use… (Government of Andhra Pradesh, 1998).
- Generating unit(s) with aggregate capacity not exceeding 166 MW, which produces power for captive consumption of its owners… (Government of Rajasthan, 1999).
- The power plant set up/proposed to be set up by a person or a group of persons for his or their own use… (Government of Madhya Pradesh, 2000).
- A power plant set up by any person to generate electricity primarily for his own use and includes a power plant set up by any co-operative society or association of persons for generating electricity primarily for use of members of such cooperative society or association… (Electricity Act, 2003).

Captive Generating plant means a power plant set up by any person to generate electricity primarily for his or her own use and includes a power plant set up by any co-operative society or association of persons for generating electricity primarily for use of members of such co-operative society or association. Note that the word primarily is not defined anywhere. Also note that by this definition, a group of industries can set up a big generating station for their groups use and sell excess power. A significant number of captive power plants (CPPs) and Independent Power Producers (IPPs) are participating in the market. The Central Electricity Regulatory Commission (CERC) is exercising regulatory oversight in this market. Captive power Plants are developed to cater the industrial demand in the scenario where the electricity supplied by the utilities is short in supply or is of bad quality. Captive plants over the years have been evolved from plants owned by single promoter to group captive to the medium of maximizing the benefit by selling its surplus power. The Electricity Act 2003 encouraged captive power generation in India and further provisions in the Act took captive power to competitive market by opening the market for players to invest in captive power generation.

Open access allows captive generators to sell power to any buyer no matter what the location. The power generation entities in India can be divided into two broad categories:

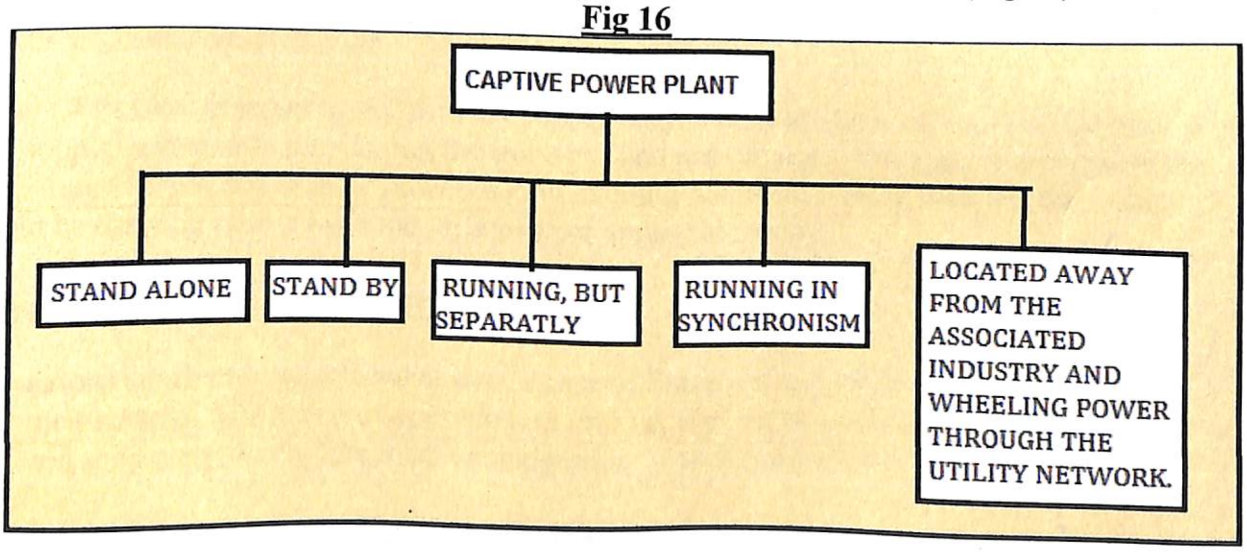
- Generation Utilities
- Generation Non-Utilities or Captive Power Plants (CPPs).

Captive power plants are a form of distributed generation, generating power close to the source of use. Distributed generation facilitates the high fuel efficiency along with minimizing losses associated with the transmission of electricity from centralized power plants.

4.2.2 CATEGORIES OF C.P.P.s:-

In the present context, Captive generation can be categorized as follows :(Fig 16)-

Fig 16



- Stand - alone, i.e. isolated from the grid
- Stand-by, i.e., normally idling
- Running, but separately
- Running in synchronism
- Located away from the associated industry, and wheeling power through the utility network.

Each of these categories has a different connotation, and would need to be treated accordingly, for effectively bringing the surplus capacity into the utilities'' network.

(1) STAND - ALONE C.P.P.s

Poor quality of grid supply (low voltage, fluctuating frequency and frequent interruptions), high tariffs (much higher than actual cost of supply), unfair impositions (peak hour restrictions and unplanned load shedding) and unresponsive attitude of SEBs have forced many industries to isolate themselves totally from the State grid and be on their own. For a reliable operation of the industry, they necessarily have to have Captive generation with a redundancy. In other words, they have available a significant amount of surplus capacity. To harness the above surplus capacity for increasing the availability of power in the grid, a pragmatic approach is required. The concerned SEBs / successor utilities have to realize that their own urge for harnessing such capacity is more pressing than the need of the CPP owner to get reconnected. In any case, the CPP owner cannot be expected to supply power if his net recovery is less than his variable cost. The utilities have to play their part, and this would include the following, at the utility's cost:-

- Constructing / restoring the line up to the industry's premises, for adequate grid connectivity.
- Providing necessary switchgear, transformers, etc., and the required metering equipment in the utility's system.
- Allowing the industry and CPP to run in synchronism with the utility's system.
- Agreeing on a reasonable commercial arrangement.
- Promptly paying for the power supplied by the CPP.

(2) STAND - BY C.P.P.s

Many CPPs have been set up for standby supply only. These are kept off most of the time, when grid supply is available for running the industry, and are run only when grid supply goes off, or the industry is told not to draw power, e.g. in evening hours. In these situations, the industry would be drawing power from the utility as per applicable tariff.

(3) SEPARATELY RUNNING C.P.P.s

For reasons similar to those listed above in case of Stand - alone CPPs, many industries have split their system, with one part operating on grid supply and the other on CPP. The two parts are operated separately due to historical considerations – technical and commercial.

(4) C.P.P.s RUNNING IN SYNCHRONISM

There are many large industries (steel plants, etc.) which have CPPs of substantial size running in synchronism with the grid, but only at part capacity due to one-sided contracts.

(5) C.P.P.s LOCATED AWAY FROM ASSOCIATED INDUSTRY

These are necessarily synchronized with the grid. Besides, the utility can separately record the injection of CPP and consumption of the associated industry.

ISLAND MODE OPERATION CAPTIVE POWER PLANT:-

Gas engines are well suited to acting in island mode operation as a captive power plant. Island mode operation relates to those power plants that operate in isolation from the national or local electricity distribution network.

Island mode operation can take two key forms:

- Stand-alone generators not connected to the electricity grid
- Generators connected to the electricity grid in parallel mode, which can generate independently in the event of a grid power supply failure

A large number of CHP plants have been installed without an electrical connection to an external electricity system. This is often as a result of the site's remote location, the unreliability of the local electricity network, or regular interruptions in power supply.

These sites operate in 'island mode'. They have the benefit of avoiding the costs of installing external site connections, but they have to manage their provision and consumption of power with no top-up or backup supplies. In particular the loading rates applied to the generator from the site machinery must be considered when engineering the gas fueled power plant. These sites usually require a high level of installed plant capacity to ensure power availability at all times. However, many of the sites that operate CHP plants in parallel mode also have the facility to operate in island mode. This provides them with the particularly useful capability of providing power to the site when the local area electricity system has suffered a supply failure.

Some sites consider that their CHP plant avoids the need to install back-up power provisions for emergency use. If a period of island mode operation is planned, it is relatively simple to ensure that the site demand is set at a level that does not exceed the net power output of the CHP plant. Once this is established, the connection to the local area system is disconnected by opening the circuit breaker. The site can then operate in island mode, with the CHP output modulating to meet site demand. The change from parallel to island mode may occur instantaneously when the local area supply system suffers an outage. In this situation, it should be possible for the CHP plant to continue supplying the site load without interruption, on condition that the site load can be immediately limited to the output level of the CHP plant. This is usually achieved using load monitoring and control equipment, which can automatically disconnect selected parts of the site load. If this load limitation cannot be achieved, the CHP plant will usually shut down when there is a failure in the local area system with which it is operating in parallel. The site will then lose all power supplies. However, as long as the site system has facilities to disconnect selected supply circuits within the site, the CHP plant can quickly be restarted to provide site power up to its maximum output level. This usually requires prompt action by the site electrical engineering staff in operating circuit breakers according to a prepared procedure. It is also necessary for the CHP plant to be equipped with a back-up power source to enable it to be restarted in the absence of external power source.

4.2.3 REGULATORY PROVISIONS

Captive power plants are a necessity for the Indian electricity scenario. Some of the important provisions highlighting captive power are listed below:

- **· Provisions for Captive Power Plants in Electricity Act 2003-**

Captive generating plant is defined

Under **Section 2 (8)**. It is a power plant set up by any person to generate electricity primarily for his own use and includes a power plant set up by any cooperative society or association of persons for generating electricity primarily for use of members of such cooperative society or association.

Section 9 (1) further stipulates that a person may construct, maintain or operate a captive generating plant and dedicate transmission lines. It also provides that supply of electricity from the captive generating plant through the grid shall be regulated in the same manner as the generating station of a generating company.

Section 42 (2) states that surcharge (for meeting the requirements of cross-subsidy) on wheeling charge shall not be leviable in case open access is provided to a person who has established a captive generating plant for carrying the electricity to the destination of his own use.

- **· Provisions for Captive Power Plants in National Electricity Policy-**

The Electricity Act 2003, the National Electricity Policy emphasizes that the liberal provision in the Act with respect to setting up of captive power plant has been made with a view to not only securing reliable, quality and cost effective power but also to facilitate creation of employment opportunities through speedy and efficient growth of industry. The provision relating to captive power plants to be set up by group of consumers is primarily aimed at enabling small and medium industries or other consumers that may not individually be in a position to set up plant of optimal size in a cost effective manner. Captive generating plants should be permitted to sell electricity to licensees and consumers when they are allowed open access by SERCs under section 42 of the Act.It needs to be noted that efficient expansion of small and medium industries across the country would lead to creation of enormous employment opportunities. The Policy further states that a large number of captive and standby generating stations in India have surplus capacity that could be supplied to the grid continuously or during certain time periods. These plants offer a sizeable and potentially competitive capacity that could be harnessed for meeting demand for power. The Government of India has initiated several reform measures to create a favorable environment for addition of new generating capacity in the country. The Electricity Act 2003 has put in place a highly liberal framework for generation. There is no requirement of licensing for generation. The requirement of techno-economic clearance of CEA for thermal generation project is no longer there. . Captive generation has been freed from all controls. Under the Act, captive generators have access to licensees and would get access to consumers who are allowed open access. Grid inter-connections for captive generators shall be facilitated as per section 30 of the Act. This should be done on priority basis to enable captive generation to become available as distributed generation along the grid. Appropriate commercial arrangements would need to be instituted between licensees and the captive generators for harnessing of spare capacity energy from captive power plants. The appropriate Regulatory Commission shall exercise regulatory oversight on such commercial arrangements between captive generators and licensees and determine tariffs when a licensee is the off-taker of power from captive plant. Towards this end, non-conventional energy sources including co-generations could also play a role.

❖ Provisions for Captive Power Plants in Electricity Rules 2005-

These rules state that no power plant shall qualify as a 'captive generating plant' under section 9 read with clause (8) of section 2 of the Act unless it satisfies the following conditions.
(a) In case of a power plant it is stipulated that not less than 26% of the ownership is held by the captive user and the user has to consume a minimum of 51 % of the aggregate electricity generated in such plant. In case the captive power plant is set up by a cooperative society, the conditions mentioned above shall be satisfied collectively by all the members. In case of association of persons, the captive users shall hold not less than 26% of the ownership of the plant in aggregate and such captive users shall consume not less than 51% of the electricity generated, determined on an annual basis, in proportion to their shares in ownership of the power plant within a variation not exceeding 10%.

(b) in case of a generating station owned by a company formed as special purpose vehicle for such generating station, a unit or units of such generating station identified for captive use and not the entire generating station should have 26% of the proportionate equity out of the total equity of the company related to the generating unit(s) identified as captive plants.
For example in a generating station with two units of 50 MW each namely Units A and B, one unit of 50 MW namely Unit A may be identified as the Captive Generating Plant. The captive users shall hold not less than thirteen percent of the equity shares in the company (being the twenty six percent proportionate to Unit A of 50 MW) and not less than fifty one percent of the electricity generated in Unit A determined on an annual basis is to be consumed by the captive users.

(c) It shall be the obligation of the captive users to ensure that the consumption by the Captive Users at the percentages mentioned above is maintained and in case the minimum percentage of captive use is not complied with in any year, the entire electricity generated shall be treated as if it is a supply of electricity by a generating company.

❖ Provisions For Captive Power Plants In National Tariff Policy

In pursuance to section 3 of the Act, the Central Government has notified on 6-01-2006 the tariff policy which among others has also emphasized the need for harnessing the Captive generation. The salient features of which are as under:-
While it is recognized that the State Governments have the right to impose duties, taxes, cess on sale or consumption of electricity, these could potentially distort competition and optimal use of resources especially if such levies are used selectively and on a non-uniform basis.
In some cases the duties etc. on consumption of electricity is linked to sources of generation (like

captive generation) and the level of duties levied is much higher as compared to that being levied on the same category of consumers who draw power from grid. Such a distinction is invidious and inappropriate. The sole purpose of freely allowing captive generation is to enable industries to access reliable, quality and cost effective power .

Particularly, the provisions relating to captive power plants which can be set up by group of consumers had been brought in recognition of the fact that efficient expansion of small and medium industries across the country will lead to faster economic growth and creation of larger employment opportunities. For realizing the goal of making available electricity to consumers at reasonable and competitive prices, it is necessary that such duties are kept at reasonable level.

❖ **Provisions of Group Captives as per Electricity Act 2003**

The provision relating to captive power plants to be set up by group of consumers is primarily aimed at enabling small and medium industries or other consumers that may not individually be in a position to set up plant of optimal size in a cost effective manner. It needs to be noted that efficient expansion of small and medium industries across the country would lead to creation of enormous employment opportunities.

- Surplus Power of Captives

A large number of captive and standby generating stations in India have surplus capacity that could be supplied to the grid continuously or during certain time periods. These plants offer a sizeable and potentially competitive capacity that could be harnessed for meeting demand for power. Under the Act, captive generators have access to licensees and would get access to consumers who are allowed open access. Grid inter-connections for captive generators shall be facilitated as per section 30 of the Act. This should be done on priority basis to enable captive generation to become available as distributed generation along the grid.

- Role of Non-Conventional Energy Sources

Towards this end, non-conventional energy sources including co-generation could also play a role. Appropriate commercial arrangements would need to be instituted between licensees and the captive generators for harnessing of spare capacity energy from captive power plants.

The appropriate Regulatory Commission shall exercise regulatory oversight on such commercial arrangements between captive generators and licensees and determine tariffs when a licensee is the off-taker of power from captive plant.

❖ **· Tariff Structuring And Associated Issues**

A two-part tariff structure should be adopted for all long term contracts to facilitate Merit Order dispatch. i.e. the capacity charge & energy charge.

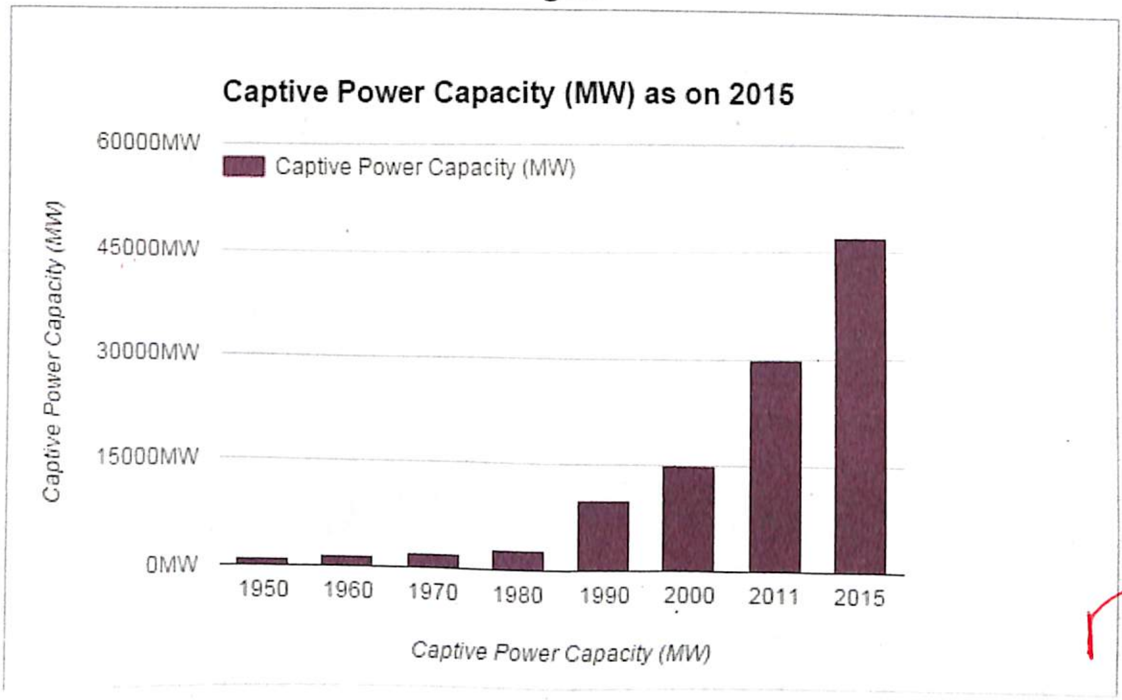
According to National Electricity Policy the Availability Based Tariff (ABT) has been introduced at State level by April 2006. This framework would be extended to generating stations (including grid connected captive plants of capacities as determined by the SERC).

The Appropriate Commission may also introduce differential rates of fixed charges for peak and off peak hours for better management of load.

4.2.4 CAPTIVE POWER SCENARIO INDIA

A captive power plant (CPP) is any generating station set up by an organization to meet its own power requirement. The CPPs cater to the electricity requirement of industrial units in a large scale. The CPPs cater to the electricity requirement of industrial units in a large scale. The Electricity Act 2003 encouraged captive power generation in India and further provisions in the Act took captive power to competitive market by opening the market for players to invest in captive power generation. Open access allows captive generators to sell power to any buyer no matter what the location. The Captive power (MW) is increasing day by day. Give a look year wise captive power installed capacity from 1950 to 2015 (Fig 17)

Fig 17



Large number of captive plants including co-generation power plants of varied type and sizes exist in the country which are either utilized in process industry or used for in-house power consumption. A number of industries have set up their own captive plants so as to get reliable and quality power. Some Captive plants are also installed as stand-by units for operation only during emergencies when the grid supply is not available. The installed capacity of CPPs has increased from 588 MW in 1950 to about 22,235 MW by the end of 10th Plan. The same has increased to about 30,000 MW in March 2011. Captive plants including co-generation power plants could, therefore, play a supplementary role in meeting the country's power demand. After the enactment of Electricity Act 2003, there is a renewed interest in captive generation. Surplus power, if any, from captive power plants is being fed into the grid as the Electricity Act 2003 provides for open access, in non-discriminatory way. Around 12,000 MW of addition of Captive Capacity is likely during 11th Plan, out of which about 9250 MW has been commissioned during the first 4 years of 11th Plan. A capacity addition of approximately 13,000 MW is likely to be commissioned during 12th Plan (April 2012 to March 2017). It is estimated that about 20% of the likely capacity addition during 11th Plan shall be surplus and can be fed to the grid. However, to harness surplus capacity from captive power plant sit is essential that various bottlenecks being faced are addressed and technical and commercial issues are resolved to make the export arrangements attractive and commercially viable.

The Installed Capacity of Captive Power Plants (1MW and above) by the end of FY 2010-11 is about 31,000 MW. A Capacity addition of around 12,000 MW is likely during 11th Plan. A capacity addition of approximately 13,000 MW is likely during 12th Plan (April 2012 to March 2017).

TABLE 9: GRID INTRACTIVE POWER AND OFF GRID/CAPTIVE POWER ACHIVEMENTS

Sector	FY- 2015-16		CumulativeAchievements
	Target	Achievement	(as on 31.08.2015)
I. GRID-INTERACTIVE POWER (CAPACITIES IN MW)			
Wind Power	2400	644.75	24088.36
Solar Power	1400	477.34	4229.36
Small Hydro Power	250	91.55	4146.9
Bio-Power (Biomass & Gasification and Bagasse Cogeneration)	400	0	4418.55
Waste to Power	10	12	127.08
Total	**4460**	**1225.64**	**37010.25**
II. OFF-GRID/ CAPTIVE POWER (CAPACITIES IN MWEQ)			
Waste to Energy	10	0.5	146.51
Biomass(non-bagasse) Cogeneration	60	10.5	602.37
Biomass Gasifiers -Rural -Industrial	2	0	17.95
	6	0	152.05
Aero-Genrators/Hybrid systems	0.5	0.13	2.67
SPV Systems	50	45.39	279.74
Water mills/micro hydel	2	0	17.21
Total	**130.5**	**56.52**	**1218.5**
III. OTHER RENEWABLE ENERGY SYSTEMS			
Family Biogas Plants (numbers in lakh)	1.1	0.05	48.23
Solar Water Heating – Coll. Areas(million m2)	-	0	8.9

In India, captive power took on a new shape when the first group captive was set up by three companies—Gujarat State Fertilizers and Chemicals Ltd, Gujarat Alkalies and Chemicals Ltd and Petrofils Cooperative Ltd, along with the Gujarat Electricity Board - Gujarat Industries Power Co. Ltd. After meeting the needs of promoter companies, the surplus was sold to the state government. Then came other large captive power plants of corporate groups such as Vedanta, Essar, Reliance, etc which sold its surplus power to the state electricity boards through 15-25 year PPAs. The opportunities emerged after the enforcement of the Electricity Act-2003 in the form of delicensing of generation, implementation of open access and setting up of common trading platform, has made the captive power plants an attractive option to industries to meet their in-house requirement on one hand to maximize their profits from sale of the surplus power from their captive plants on the other.

Apart from the mentioned benefits, other ones are associated with the option of selling the surplus power through the power exchanges, depending upon the technology used claiming the incentives under clean development mechanism (CDM), earning energy efficiency certificates, and renewable energy certificates. Although the trading of these certificates is currently not in practice in India but very soon this is to be adopted in Indian power markets.

On the other hand the Government is also making a conscious attempt to encourage captive generation by earmarking the coal blocks to be dedicatedly used by these plants. The installed captive power generation capacity (above 1 MW capacity) in the industries is 47,082 as on 31 March 2015. Another 75,000 MW capacity diesel power generation sets (excluding sets of size above 1 MW and below 100 KVA) are also installed in the country. In addition, there are innumerable DG sets of capacity less than 100 KVA to cater to emergency power needs during the power outages in all sectors such as industrial, commercial, domestic and agriculture. Have a look in captive power generation based on source(Table 10)

TABLE 10: SOURCES BASED CAPTIVE POWER GENERATION UPTO 31.03.2015.

Captive Power Generation

Source ⬍	Captive Power Capacity (MW) ⬍	Share ⬍
Coal	27,588	58.60%
Hydroelectricity	83	0.17%
Renewable energy source	Included in 'Oil'	
Natural Gas	5,215	11.08%
Oil	14,196	30.17%
Total	**47,082**	**100.00%**

CPP capacity grew at a CAGR of 5% during the last 5 years (FY04-FY08) and industrial and commercial demand were the drivers of growth. Increasing demand from industrial consumers, who are suffering from inadequate power supply and high tariff rate charged by State Electricity Boards (SEBs), find captive generation as the best alternative for meeting their demand. Coal-based generation dominates captive power generation also and constitutes around 42% of the captive capacity. Another reason for higher capacity of coal-based captive generation is the cost of generating electricity from coal, which is cheaper than diesel and naphtha. Different industries like manufacturing, commercial, service, hospitality, as well as educational institutions have captive power capacity based on diesel generators. In recent times, cogeneration and waste heat recovery are emerging as the best alternatives among all fuel types for CPPs, as companies get the Clean Development Mechanism (CDM) benefits under this system in addition to achieving energy efficiency.

The industry in India pays among the highest tariffs in the world and is not assured of the quality of supply. In this era of globalization, it is essential that electricity of good quality be provided at reasonable rates for economic activity so that competitiveness increases. In the last two plan periods barely half of the capacity addition planned was achieved. The optimistic expectations from the IPPs have not been fulfilled and in retrospect, it appears that the approach of inviting investments based on Government guarantees was perhaps not the best way. The energy as well as peaking shortages across the country is a matter of concern and the situation would have been worse but for the slowdown in manufacturing sector.

However, a number of industries are now increasingly relying on their own generation (captive and cogeneration) rather than on grid supply.

The future of captive generation is very bright as industrial demand will keep on increasing and activities like trading through exchange will provide a platform to captive generators to sell surplus power at a profitable margin.

4.2.5 CAPTIVE POWER POLICY

4.2.5.1 FORMAT OF WRITING OF CAPTIVE POWER POLICY

1.0 OBJECTIVE

According to the 16th Electric Power Survey conducted by CEA, the country has energy shortage of 7.8% and peaking shortage of 13.0% for the current year. The capacity addition required by the end of 11th Plan to meet these shortages is nearly 100,000 MW. In view of the massive investments required for capacity addition it is necessary that the existing investments in the power sector are fully utilized and captive power plants which are utilized only partially are encouraged to sell power to the grid. The following general guidelines are recommended to the States to enable a more liberal framework for setting up Captive Power Plants and utilizing their surplus output for benefit of the consumer.

2.0 PERMISSION AND APPROVAL:

i) Permission for installation of Captive Power Plant is to be obtained from SEB under Section 44 of Electricity (Supply) Act, 1948. For captive power generation exceeding 25 MW, SEB will accord permission under Section 44 of Electricity (Supply) Act, 1948 only after consulting the Central Electricity Authority as per Section 44 (2A) of Electricity (Supply) Act, 1948.

ii) The following would be eligible to install a Captive Power Plant:-

a) A consumer of electricity
b) A group comprising more than one consumer as a joint venture.
c) An actual user of power but not a consumer.
d) A group of actual users of power, but not consumers, as a joint venture.
e) A group comprising both consumers and actual users of power as a joint venture but excluding A Generating Company@ as defined under Section 2(4-A) of Electricity (Supply) Act 1948.

3.0 CATEGORY:

- If the captive plant falls under the category of hydro or co-generation plant, such plant, irrespective of its size and status of power supply position in the State, may be permitted liberally.
- If the Captive Power Plant is based on coal or liquid fuel or gas and if the State is deficit in power supply, the installation of such captive power plant could normally be allowed and the capacity of the plant permitted up to 200% of the requirement of the industry for its own use.
- If the Captive Power Plant is based on coal, liquid fuel or gas and the State is surplus in power, the installation of such captive plants can still be considered in the following cases:-
- If the industry requires uninterrupted power supply due to the nature of the industry and if the State/SEB or Successor entities are not able to guarantee supply of such requirements, the proposal for setting up of such a captive power plant for the uninterrupted power supply requirement of the industry can be considered.
- If the industry requires quality power supply (within the stipulated variations in voltage and frequency) and if the State/SEB or Successor entity are not in a position to guarantee the power supply of such stringent requirements, the proposal for installation of the captive power plant of the required capacity can be considered.
- If the cost of generation from the captive plant is found to be lower compared to the tariff of the power supply from the grid, the proposal may be considered after thoroughly examining the cost and tariff aspects.
- Banking facilities may also be provided to the Captive Power Plants so that available

capacities are utilized to the extent possible and when required. The rates for banking may be determined on mutually agreed terms.

- Units in Special Economic Zones (SEZ) and industrial estates may be allowed to set up CPPs liberally.

4.0 If the CPP is of co-generation in nature, and the capacity exceeds 25 MW, the proposals shall be forwarded to CEA for consultation under Section 44(2A) of Electricity (Supply) Act, 1948 duly certified by the concerned Utilities that the proposal qualifies for the status of co-generation.

5.0 PERMISSION of State Electricity Board is required to synchronize and operate with the Grid.

6.0 ALL STATUTORY CLEARANCES for setting up the CPP have to be obtained by the owner of the CPP of his own accord.

7.0 CONDITIONS FOR USAGE OF CAPTIVE POWER

Energy generated from captive power generating units:

a. Can be used by the owner of the captive power generation plant.
b. Can be used by sister concern (s) of the owner of the captive power generation plant.
c. Balance power after usage in items (a) and (b) above can be sold to SEB, if required by them.
d. Third Party sale is also permissible, with the approval of SEB.
e. Captive generator could be asked not to draw power from the grid during peak seasons/hours.

8.0 WHEELING CHARGES & RULES

Prior approval of SEB has to be obtained for wheeling of power. Captive generated power may be wheeled only where interface for synchronization with the grid exists. Wheeling will be done to any service (High Tension or Low Tension). The cost of interfacing lines, switchgear metering and protection arrangement may be met by the CPP and/or the Board as per mutual arrangement. Similarly, the wheeling charges may be worked out based on pooled rates of wheeling charges worked out by the Central State Transmission Utility of that Region and the amount of energy wheeled.

9.0 PRICING OF THE BALANCE POWER SOLD TO S E B

a. For the FIRM POWER, the pricing for the Captive Power Generation could be in single part i.e. rated for units alone. The tariff for sale of power from thermal CPPs to SEB may be fixed after mutual discussions between SEB & CPP and could be based on pooled variable charge of thermal power stations operating in the SEB plus some percentage of the pooled variable charges as an incentive to CPP generator. In case of hydro CPPs also, the tariff for sale of power to SEB may be fixed after mutual discussions between SEB & CPP and could be based on pooled variable charge of thermal power and incentives. To attract more power from CPPs into the Grid, tariff could also be based on the highest variable cost in the system or the actual variable cost of CPP, whichever is lower, and some percentage of the variable cost as an incentive.

b. The rate for INFIRM Power could be at 75% of the normal rate.
c. Tariffs for purchase of power from captive plants may be determined by SERCs wherever they have been established.

10.0 BILLING METHODS

i) Separate billing may be carried out for export and import of power by the Captive Power Generator. Import of power may be billed according to the Tariff Notifications of Government from time to time.

ii) Export billing may be done for the units exported as per the mutual agreement between SEBs & CPP.

11.0 DEFINITIONS

Definitions are

a) CONSUMER means any person who is supplied with electric energy by a State Electricity Board.
b) ACTUAL USER OF POWER means one who is not a consumer but uses power out of captive power generation.
c) GRID means electrical network of a State Electricity Board
d) BOARD means State Electricity Board or its successor entities.
e) CPP means Captive Power Plant.
f) FIRM power means quantity of power in units committed by the owner of the Captive Power Plant to be sold to State Electricity Board annually.
g) INFIRM power means quantity of power in units sold to SEB without any commitment.
h) CAPTIVE POWER PLANTS may be defined as plants meant for catering to the needs of a particular industry/consumer or group of industries/consumers for their own use, which should be not less than 50% of the total output of the plant.
i) GENERATING COMPANY means a company registered under the Companies Act, 1956 and which has among its objects the establishment, operation and maintenance of generating stations

4.2.5.2 POLICY GUIDELINES OF GOVERNMENT OF STATES FOR INSTALLATION OF CAPTIVE POWER GENERATION

1. APPLICANTS ELIGIBLE FOR CAPTIVE POWER GENERATION

- Software/ Hardware technology parks declared by Government.
- Techno parks declared by Government.

- Industrial parks declared by Government.
- Kinfra parks established/declared by Government.
- Industrial estates declared by Government.
- Industrial growth centers declared by Government/ State Industrial Development Corporation.
- Export Processing Zone declared by Government.
- Existing licensees.
- Existing Industries.
- New Industries.

2. CAPACITY OF CAPTIVE POWER PLANT (CPP):

Minimum: 3 MW, Maximum: 25 MW

3. GENERATION VOLTAGE AND FREQUENCY:

The CPP shall be three phases,50 Hz, 11 KV.

4. GENERAL CONDITIONS

The applicants in items 1 to 7 are allowed to install CPP for the use of the consumers within the Parks/Estates/Centers. Those applicants can sell the power generated from the CPP to the consumers within the Parks/Estates/Centers. For this purpose, the applicants will be declared as sanctioned holders. They shall apply to Government for declaring them as sanction holders as per Section 28 of the Indian Electricity Act, 1910 and obtain sanction.

5 .STATUTORY SANCTION/CLEARANCE.

It is the responsibility of the applicants who desires to install CPP to obtain all statutory clearances/ sanction from the respective authorities.

6. CONSUMPTION AND SALE OF ENERGY

- The State Electricity Board will not purchase energy from the CPP having the capacity of less than 3 MW.
- The owners of the CPP can consume the energy generated from the CPP for their own use. They shall not sell energy generated from the CPP to anybody else other than the KSB Board. The KSB Board will purchase the energy generated from the CPPs fully or the excess quantity. The purchase price will be at the rate determined on mutually agreed terms.
- As far as licensees are concerned, they can sell energy generated from the CPP to the consumers within the licensee=s area and also to the SB Board. But the licensees shall not sell the energy generated from the CPP to anybody else other than the consumers within the licensee area or SB Board. The selling price of energy to the Consumers within the area of the licensee shall be determined by the licensee. But the selling price of energy to the SE Board will be determined on mutually agreed terms.
- The licensees/sanction holders having CPP can purchase energy from SE Board. But the

licensee/sanction holder will not get the privilege of grid tariff for this purchase. The price will be at the rate determined by the Board.

- The SE Board will sell the energy purchased from the CPPs back to CPPs at a pooled price determined by the KSE Board and taking into consideration the price at which energy was purchased from the CPPs.
- SE Board will not purchase energy from the CPPs between 2200 hours and 0500 hours.

7. SANCTION FOR INSTALLATION OF CPP.

- The Deputy Chief Engineers, Transmission Circles in the respective shall be authorized to accord sanction for installation of CPPs having capacity less than 3 MW for which applicants have to send the applications to the respective Deputy Chief Engineers, Transmission Circles. The Deputy Chief Engineers will give a decision within one month, failing which it will be presumed that he has no objection and the applicants can go ahead with installation of generators.
- Sanction for installation of CPPs having capacity 3 MW and above shall be accorded by the KSE Board. The applications in such cases shall be sent to the Chief Engineer (Thermal & Commercial) Vaidyuthi Bhavan, Pattom. The K.S.E.B. shall communicate a decision within 45 days, failing which it will be presumed that KSEB has no objection for installation of generators.

8. BANKING OF ENERGY

The excess energy generated from CPP wheeled to the SEB grid can be banked for a period not exceeding one month from the date of wheeling. The Board will charge 2 paise per unit for the energy banked per month or part thereof. Banking is not permissible between 2200 hrs. and 0500 hrs.

9. SETTLEMENT OF BILLS

The energy transaction will be billed and settled on monthly basis by the Special Officer (Revenue), SEB

10. GRID DISCIPLINE

The owners of CPP have to abide by grid discipline and will not be entitled for any compensation in the event of grid failure due to force-majeure conditions, fluctuation in voltage, frequency or other reasons. The same condition will apply for synchronization of CPP with SEB grid

11. METERING

- The owners of CPP have to install Time of-Day meter having import-export registering facility and allied equipment's at their cost in the nearest 66 KV, 110 KV or 220 KV sub station of the KSE Board, where the power from the CPP is wheeled to the KSEB grid. The meter and allied equipment's will be the property of the owners of the CPP. It is their responsibility for their upkeep and replacement. If the meter and or the allied equipment's become defective or cease to register the quantity of electricity the, owners of CPP shall replace it by a good meter /equipment within one month of they becoming defective /ceases to register. If the owners of CPP fail to replace the defective meter/equipment within the said period of one month, the KSE Board will discontinue the purchase or sale of energy from the CPP until the meter / equipment's is replaced by good meter/equipment.

- The SE Board will provide a check meter near to the very same location where the owner of the CPP has installed his own meter.

12. METHOD OF BILLING

The method of billing of the energy transaction will be as per the guidelines issued by the SREB for the interstate exchange of energy. The same procedure will apply during the period when the meter or the allied equipment of either parties are defective or cease to register the quantity.

13. CALIBRATION OF THE METERS

The meters installed by both the parties will be jointly calibrated before installation. The recalibration will be done jointly once in every six months from the date of installation. If recalibration is found necessary for a lesser period due to any reason, it shall be done jointly.

14. INTERFACING WITH SEB GRID

- The CPPs having capacity of 3 MW and above alone will be permitted to be synchronized in the SE Board Grid Substation. The synchronization shall be done at the agreed voltage as per the scheme approved by Chief Engineer. The owner of the CPP shall send detailed scheme to the Chief Engineer (thermal & Commercial), Vaidyuthi Bhavan, Pattom, Thiruvananthapuram.
- The equipment for synchronization, control, protection step up /step down transformer and inter locking shall be purchased and installed by owner of the CPP at his cost.
- The owner of the CPP has to construct the transmission line at his cost for wheeling the power generated from the CPP to the nearest 66 KV, 110 KV or 220 KV grid substation of the KSE Board.

15. INDEPENDENT USE OF POWER FROM CPP

If any industry or licensee wants to install captive power plant for its own use independently, there shall not be any possible inter connection between its load fed by its generation and SEB supply. The industry or licensee shall purchase and install change over switch or circuit breaker with inter lock at its cost, as per the scheme approved by the Chief Engineer (Generation) for which detailed scheme shall be sent to the Chief Engineer (Generation).

16. REDUCTION OF CONTRACT DEMAND

No reduction in contract demand and or rebate in MP charge shall be allowed in proportion to the energy wheeled or sold to KSE Board.

17. POWER SUPPLY DURING SHUT DOWN/MAINTENANCE OF CPP.

The SEB will supply the power required for the construction of CPP at the rate applicable to other consumers to whom SEB sells power. The owner of the CPP has to remit the cost of construction of the power line / installation of all equipment in advance. The power supply will be provided on out of turn priority.

18. CONSTRUCTION POWER

The SEB will supply the power required for the construction of CPP at the rate applicable to other consumers to whom SEB sells power. The owner of the CPP has to remit the cost of construction of the power line /installation of all equipment in advance. The power supply will be provided on out of turn priority.

19. FUEL

The owner of the CPP can use any fuel permitted by the Government of India or any other statutory authority. Non-conventional sources can also be used as per the terms laid down by the competent authority. The tariff for the power generated will be worked out on mutually agreed terms subject to the notification dated 30.03.92 of Government of India and its subsequent amendments, if any. It is the responsibility of the owner of the CPP to obtain fuel allocation and all other clearances.

20. COMMITMENT CHARGES

If the owner of the CPP wants to keep the SEB supply as stand-by, he has to pay to SEB, stand by commitment charge which will be equal to double the demand charge applicable as per the tariff notification issued by SEB from time to time for the voltage class applicable to other consumers. This is in addition to energy charge.

21. ELECTRICITY DUTY

The owners of the CPP are exempted from payment of Electricity duty for the energy generated and consumed by their units for a period of next five years. But they should pay electricity duty for the energy sold outside their jurisdiction allowed by these rules.

22. SUBSIDY / FINANCE

The SE Board will not pay any subsidy or render any financial assistance to the owners of the CPP for the installation of the power plant.

23. TARIFF CONCESSION / SUBSIDY / INCENTIVES

In respect of industries eligible for concessional tariff / incentives subsidies the SE Board will to take into account concession / incentives / subsidies for determining the tariff for the power purchase by the SE Board from CPP or sold to them.

24. LAND

The land whether private or Government required for installation of CPP has to be purchased by the owner of the CPP.

25. EXEMPTION FROM POWER CUT

The owner of the CPP can consume the power generated from the captive power plant without any restrictions during the period of power cut for their own use or use of their consumers.

26. WHEELING CHARGES AND LOSS ON TRANSMISSION

Wheeling charge at two percent (2%) of energy wheeled an Transmission loss at ten per cent

(10%) of the energy wheeled will be debited to the account of the owner of the CPP.

27. PENALTY FOR LOW POWER FACTOR

- The owner of the CPP has to install suitable meter to record the power factor of the CPP at his cost. If no such meter is installed, the power factor shall be determined by taking the ratio of the reading of the Kwh and KVAh taken monthly.27.2 The power factor of the CPP shall be maintained not less than 0.95 lag by the / owner of the CPP at his cost, if it drops below 0.85 lag, the selling price of energy by the owner of the CPP to his consumers or to the KSE Board shall be reduced as indicated below :- Below 0.85 lag up to 0.75 lag 2% of the energy charge for every reduction of 0.01 power factor from 0.85 lag. Below 0.75 lag 3% of the energy charge for every reduction of 0.01 power factor from 0.85 lag. Should the power factor drop below 0.75 and so remain for a period of two consecutive months it must be brought to not less than 0.85 within a further period of six months by the owner of the CPP failing which without prejudice to the right of the Board to reduce the selling price of energy from the CPP and without prejudice to such other rights as having accrued or any other rights of the Board, the wheeling of the power generated from the CPP to the SEB grid, synchronization with the KSEB grid and purchase of power by SEB will be discontinued.

28. SUBMISSION OF APPLICABLE

The parties interested in installation of CPP have to submit the applications to the Chief Engineer (Thermal & Commercial) KE Board, Vaidyuthi Bhavan, Pattom, and Trivandrum 695004.

29. TIME OF COMPLETION OF THE PROJECT

The owner of the CPP to whom approval has been granted by the Board shall commission the CPP, synchronize with SEB grid and put into commercial operation within one year of the date of approval of the scheme by the Board failing which the SE Board will not purchase the power from the CPP.

30. AGREEMENT

The owner of the CPP to whom sanction has been accorded has to execute an agreement with Chief Engineer (Thermal & Commercial).

4.2.6 CAPTIVE POWER POLICY OF DIFFERENT STATES

❖ **PUNJAB**

FIG 19 MAP OF PUNJAB IN INDIA MAP

A CPP may itself use or sell electricity to a Licensee or an Open Access customer in accordance with provisions of Section 9 of the Act.

A CPP intending to supply electricity to a Licensee will bear the cost of the switch yard and interconnection facilities up to the point of injection into the grid substation of the Licensee. In case the quantum of such electricity is 3 MW or more, the cost of the bay, breaker in the Licensees grid and equipment for communication of real time data to SLDC will also be borne by the CPP. Specifications of the synchronization and other equipment including technical details of connectivity will be prescribed by the Licensee and the CPP will ensure compliance therewith.

The CPP will inject reactive power which will not be less than 62% of the active energy to be supplied to the grid. Any shortfall in the injection of reactive energy will be charged as per rates approved by CERC. Power from a CPP will be purchased as and when it is generated and the merit order will not be applicable in such a case. Tariff for sale of Firm power from a CPP to a Licensee will be equivalent to tariff rates applicable to LS (General Category) consumers. These rates will be applicable when power is supplied for a period of up to five years. For a period beyond five years, power will be purchased through competitive bidding process. Infirm Power will be paid for by the Licensee at UI rates notified by the Central Electricity Regulatory Commission. A CPP may sell electricity to a third party which is a consumer of the Licensee subject to compliance with the Open Access Regulations notified by the Commission. The State Transmission Utility and the Licensee will facilitate such third party sale.

Charges in the form of one time permission fee will be payable by a CPP seeking connectivity with the grid and operation in synchronism with the grid, at the rates specified in the Tariff Order/ Schedule of General Charges. A CPP connected in parallel with the grid, will ensure compliance of the State Grid Code & Indian Electricity Grid code. A CPP supplying electricity to a Licensee in excess of 10 MW will furnish its Annual Maintenance Schedule (1st April to 31st March) to the SLDC and the Licensee by the 15th of November of the previous year. In the case of a CPP supplying electricity less than 10 MW, its Annual Maintenance Schedule for the succeeding year will be furnished to the Licensee by 31st of March of the current year.

A CPP will intimate planned outages to the SLDC with details of their commencement, estimated duration and resumption of generation, at least an hour in advance. In the case of an unplanned outage, the CPP will inform the SLDC and the Licensee both of the stoppage of its power plant and resumption of generation within 15 minutes of their occurrence. A CPP seeking to sell power to a Licensee will enter into a contract with the Licensee on mutually agreed terms & conditions for sale of Firm Power.

Metering point will be on the high voltage side of the step up transformer in the CPP premises. Meters, metering procedures, type of meter and its testing etc. will be as per the State Grid Code notified by the Commission. Based on the energy account prepared by the SLDC, a CPP will raise bill(s) at the end of each billing cycle for electricity actually injected after accounting for energy drawl, if any, from the Licensee. Other charges such as meter rentals, commitment charges, Open Access charges payable to the Licensee, etc. will also be taken into account while preparing the bills. Payment of such bills will be effected by a Licensee in the same period as is applicable to LS consumers of the Licensee. The Licensee will be liable to pay surcharge in case of delayed payments at the rate as applicable to LS consumers.

❖ RAJASTHAN

FIG 20 MAP OF RAJASTHAN IN INDIA MAP

- A Captive Power Plant supplying Power to Captive Power Consumer/s wholly using its own independent transmission lines and not connected with the RVPN's grid system would be considered Category 'A' Captive Power Plant.
- A Captive Power Plant supplying power to Captive Power Consumer/s wholly using RVPN/Discom's transmission lines would be considered Category 'B' Captive Power Plant.
- A Captive Power Plant supplying power to Captive Power Consumer/s, partly using RVPN/Discom's and partly its own independent transmission lines and connected with the RVPN/Discom's grid system would be considered Category 'C' Captive Power Plant.
- Captive Power Consumers who have contract demand from the Discom(s) would be referred to as Category-I. Captive Power Consumer, while those who do not have the

same would be referred to as Category-II. Captive Power Consumer.

✓ **Fuel Source and Capacity Restriction**

The Captive Power Plant may use any conventional fuel subject to restrictions imposed by GOI. Captive Power Producer shall be responsible for arranging allocations, linkages and clearances required for the fuel for the Captive Power Plant from the concerned authority. Installed generating capacity of the Captive Power Plant of Categories 'B' & 'C' shall not exceed the demand of its consumers and prescribed line losses.

✓ **· Voltage of supply**

The voltage of supply of power to RVPN/Discom(s) grid from Captive Power Plants (Categories 'B' and 'C') shall be subject to RVPN/Discom's approval, but shall normally be as under :-
Upto 10 MW 33 kV Upto 50 MW 132 kV
In excess of 50 MW 132 kv or 220 kV (at RVPN/Discom's option)

Nominal frequency for power supply will be 50 Hz. However flow of energy will be regulated as per the instructions of State Load Despatch Centre as per system requirement in the high frequency regime. Amended vide Notification No. F.12(17) Energy/93 Dated : 26 Feb.2002 issued by GOR.

The Power factor of power delivered by Captive Power Plant shall normally be 0.8 (lag.) Supply of power by Discom(s) to Captive Power Plant during the construction, startup and shut down of Plant will be at HT large industrial load tariff.

✓ **System Stand by Charges/ Fixed Charges**

The captive Consumers of Category-I will be required to pay "fixed and other charges" to Discom(s) as per applicable tariff determined by Rajasthan Electricity Regulatory Commission.

CPP of category "B" and "C" requiring RVPN/ Discom(s) system standby support will be required to bear system standby charges @ Rs. 4.5 lacs per MVA per year payable on monthly basis in advance and indexed to the H.T. large industrial tariff applicable as on 1.7.99.

✓ **Wheeling/Transmission Charges & T&D Losses**

Captive Power Plants using RVPN/Discom's Grid System for wheeling of power/ energy will have to bear wheeling charges and T&D losses equivalent to 12.5% of the energy supplied for wheeling to the Captive Power Consumers at 132 kV (and above) and 17.5% of the energy supplied for wheeling to the Captive Power Consumers at 33 kV.

✓ Inadvertent flow of power to RVPN

The policy does not envisage regular sale of surplus energy to the RVPN grid. However, only inadvertent net flow of power/energy to the RVPN grid at a system frequency upto 50.2 Hz. shall be paid at a rate of 65% of H.T. large industrial tariff including fuel surcharge applicable to large industrial loads for the months of November to June and @ 60% of the energy charges applicable under large industrial tariff for the months of July to October.

- In case of supply of surplus power in the RVPN Grid at system frequency above 50.2 Hz., the rate of inadvertent supply of such energy shall be @ 70 paisa per unit. In case it is not possible to determine the inadvertent flow of energy above & below 50.2 Hz. due to absence of frequency based data of consumption of each consumer, the same shall be determined pro rata on the basis of frequency profile of delivered energy. For this purpose the Captive Power Plant will maintain a daily log of hourly generation and frequency, a copy of which will also be furnished to the RVPN/Discom(s) on a daily basis. Amended vide Notification No. F.12(17) Energy/93 Dated : 26 Feb.2002 issued by GOR.
- Incorporated as per Notification No. F.12(17) Energy/93 Dated : 26 Feb.2002 issued by GOR.
- Modified as per Notification No. F.12(17)Energy/93 Dated 18.01.2003 issued by GoR. Sale of power from Captive Power Plant to consumers outside the State will not be permitted. All Captive Power Consumers drawing power from Captive Power Plant through RVPN/Discom(s) system will abide by General Conditions of Supply of Power from Discom(s).

❖ WEST BENGAL

FIG 21 MAP OF WEST BENGAL IN INDIA MAP

Transmission and wheeling of power generated: The Wheeling facility will be provided by the WBSEB/CESC at a uniform wheeling charge of 2% of cost of power wheeled, irrespective of the distance from the generating station.

- Banking facilities: The board permits the electricity generated to be banked for a period of six months.
- An industrial undertaking not carrying on continuous process of production may draw power from the bank at any time of the day except during evening hours.
- Sale of power to WBSEB/CESC: The generated power not used by the industrial undertaking within a period of six months will be deemed to have been sold to the WBSEB/CESC.
- Tariff for sale of power will be determined for each generating station separately upon consideration of various factors such as generating cost based on total investment (less central govt. grant), debt equity ratio, depreciation, O&M, return on equity, debt service conditions, etc., as is done for large thermal/hydro power generating station

❖ GUJARAT

FIG 22 MAP OF GUJRAT IN INDIA MAP

Any industrial undertaking to set up captive power plant requires the consent of the Gujarat Electricity Board (GEB) .

Wheeling of electrical power from captive power plant of an industrial company to the other industrial units within the same company or to any/all industrial units of its group companies is allowed. Minimum quantity of power to be wheeled shall not be less than 5% of the installed capacity of the captive power plant or 5MW, whichever is more, among the group companies taken together subject to the condition that supplying company consumes at least 50% of the generated power. Wheeling charges are 13.5 paisa per kWh and 21 paisa per kWh for power delivered at EHV and HV level respectively subject to revision from time to time Wheeling of power is also not allowed when system frequency is 51 Hz and above

No night hour tariff concession shall be admissible for power consumed/drawn from the grid during night period. System losses shall be considered as 10% for power delivered at EHV and 15% in case of power delivered at HV and the same would be deducted from the account of recipient unit.

The rate for purchase of surplus power would be decided by GEB and will depend on the fuel being used and would be on cost plus basis, where the fuel cost will be decided by GEB on normative basis for each quarter for each type of fuel and gross calorific value.

The State government is empowered to prescribe terms and conditions relating to electricity supply and tariff for such supply. The electrical energy supplied/wheeled to different recipient units of group companies from captive power plant of a supplying company would be subjected to payment of Electricity Duty as per schedule I of the Bombay Electricity Duty Act, 1958 and Tax on sale of electricity as per the provisions of Gujarat Tax on sale of electricity Act, 1985, as amended from time to time.

❖ ORISSA

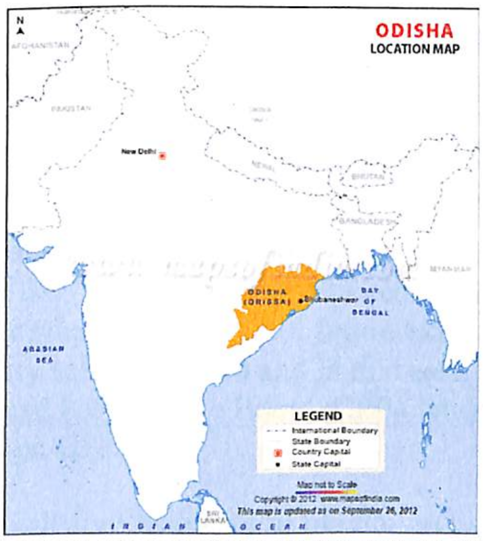


FIG 23 MAP OF ORISSA IN INDIA MAP

- The capacity of the cogeneration/captive power plant will be limited to the extent required to meet 100% of the heat and power requirement of the industries concerned on a sustained basis or to a larger extent necessary for the economic viability of the project.
- The permission for setting up Cogeneration/captive power plant will have to be obtained from the Orissa Electricity Regulatory Commission (OERC).
- Surplus power from such plants would be purchased by the GRIDCO after negotiation on a project to project basis.
- The Cogeneration/captive power plant may be set up either by the promoters themselves or by a separate company and shall abide by all relevant Acts and Rules in force primarily the Indian Electricity Act, 1910, the Electricity Supply Act, 1948 and Orissa

Electricity Reform Act, 1995.

- GRIDCO will permit wheeling of power over its transmission system subject to carrying capacity of the transmission system. It will also allow sale of surplus power by the industry to other industries within and outside the state to the extent permitted by State government. Bilateral sale to the other state will be permitted on a specific approval of the state government
- Interconnection of the Cogeneration/captive power plant with the State Grid would be at the cost of industry satisfying the technical requirement.

❖ MAHARASHTRA

FIG 24 MAP OF MAHARASHTRA IN INDIA MAP

The permission for installation and running the captive power plant will be granted by the government and the capacity of the CPP will be limited to cover the existing demand (MW) plus 1/3 of existing demand in MW or demand in MW for future expansion.

- Third party sale is allowed and in this case a tripartite agreement will have to be signed between the Board, CPP owner and the third party receiving power from CPP.
- CPP can sell surplus power to maximum two industrial units and is also restricted up to 25 percent of the generated units (kWh).
- Captive generating company or any other company intending to sell surplus electricity to third parties would require a prior permission from the Energy Department of the State Government under section 28 of the Indian Electricity Act 1910.
- The wheeling charges and transmission losses are determined in terms of distance transmitted. The wheeling charges and transmission losses are determined as 2% and 5% respectively for a distance of 050 km; 4% and 8% respectively for a distance of 50200 km; and 6% and 10% respectively for a distance above 200 km.

- Rate at which surplus power would be purchased would be decided by MSEB and it will
- In case of planned shut-down of the CPP, the excess demand recorded over and above the revised contract demand will be charged at double the normal demand charge rate of the respective tariff in force from time to time.

4.2.7 PRIVATE POWER PROMOTION THROUGH CAPTIVE POWER /CO-GENERATION ROUTE.

Since the announcement of private power policy of the Government of India in 1991, a number of proposals, including a large number of proposals from foreign promoters, have been received through Independent Power Producer (IPP) route. However, as the gestation period for large power projects is long, we will be able to complete very few projects in the near future and, therefore, we would face huge shortage of power. At the end of 1996-97, the energy shortage is visualized at 15% and peaking shortage at 30%.

There is a need, therefore, to open an alternative route other than Private Generating Company, where the industries themselves will be interested to meet their own power demand by pooling resources together. Captive Power Plants offer such an alternative. The captive power plants of industries may be allowed to sell their surplus power, if any, to the Grid, on a remunerative tariff, as per mutually agreed terms. Setting up of captive power plants would quickly add to the generating capacity in the country. I would also like to add that Co-generation and small power production is an important ingredient of private power policy in a number of countries.

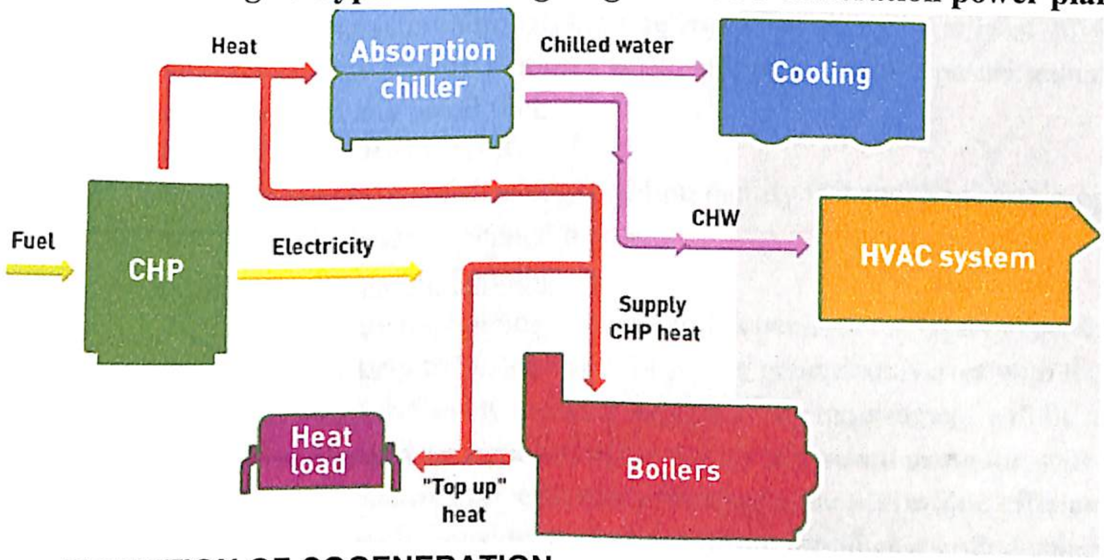
Few developing countries, in their recent restructuring process of the electricity sector have brought out important changes, among others, open access to the transmission system of the State grid on payment of mutually agreed wheeling charges for facilitating new entrants in the power sector on the captive power/co-generation route. The States can assure such an entry to the new proposed captive/co-generation power plants.

Create an institutional mechanism which may allow captive power units an easy and automatic entry into the Power Sector by quickly clearing captive power applications by State Governments, and giving them rational tariff for purchase of surplus power by the grid and third party access for direct sale of power to the other industrial units

4.3 COGENERATION POWER PLANTS

Cogeneration or combined heat and power (CHP) is the use of a heat engine or power station to generate electricity and useful heat at the same time. Tri generation or combined cooling, heat and power (CCHP) refers to the simultaneous generation of electricity and useful heating and cooling from the combustion of a fuel or a solar heat collector. The detail working diagram of cogeneration power plant below in fig 25.

Fig 25 Typical working diagram of Co-Generation power plant



- **DEFINITION OF COGENERATION**

A cogeneration facility is defined as one which simultaneously produces two or more forms of useful energy such as electric power and steam, electric power and shaft (mechanical) power etc. Cogeneration facilities, due to their ability to utilize the available energy in more than one form, use significantly less fuel input to produce electricity, steam, shaft power or other forms of energy than would be needed to produce them separately. Thus by achieving higher efficiency, cogeneration facilities can make a significant contribution to energy conservation.

❖ **OBJECTIVES OF THE POLICY**

As electricity and heat are fundamental inputs to most of the industrial activities the present policy strives to achieve the dual objectives of achieving higher efficiency in fuel use in the industry as well as the availability of surplus electricity to the State grid, by combining power and heat generation for industrial use.

❖ **PROCESS FOR CREATION OF COGENERATION FACILITY**

With a view to promote setting up of cogeneration plants, it is proposed that the industry having cogeneration potential would be allowed to develop a power generating facility without necessarily going through the competitive bidding process, for projects of any size. In addition, in such cases the projects for the purpose of CEA clearance would be treated in the same way as any proposal for setting up of captive plant is required to be treated by the State Government under section 44 of the Electricity (Supply) Act, 1948.

❖ **COGENERATION PLANTS**

Two basic cogeneration cycles have been identified:

A) Topping Cycle: Any facility that uses fuel input for power generation and also utilizes for useful heat for other industrial activities. In any facility with a supplementary firing facility, it would be required that the useful heat, to be utilized in the industrial activities, is more than the heat to be supplied to the system through the supplementary firing by at least 20%.

B) Bottoming Cycle: Any facility that uses waste industrial heat for power generation by supplementing heat from any fossil fuel.

❖ **QUALIFYING REQUIREMENTS**

A facility may qualify to be termed as cogeneration facility if it satisfies certain operating and efficiency standards which are explained below.

(I) Qualifying Requirements for Topping Cycle:

The qualifying requirements for topping cycle would depend on the type of fuel used as the overall efficiency levels likely to be achieved for power generation varies with the choice of fuel. Essentially, any cogeneration facility meeting the efficiency requirement will be more efficient than any combination of separately generated electricity and steam using the state-of art-technology. As such while setting the efficiency standards, the achievable efficiency in case of a particular fuel has been kept in consideration. In addition, for all cases of cogeneration facility, it would be required that at least 20% of the total energy output is
in the form of useful thermal energy.

As the cogeneration project would be feeding power to the state grid, in order to maintain grid stability and facilitate proper planning of the power system, it would be required that the cogeneration facility must be available to supply at least 5MW of power for at least 250 days in a year.

a) Using coal as fuel

Assuming that the achievable thermal efficiency for power generation using coal as fuel hovers around 35% while the boiler efficiency for steam generation observed in Indian industries is about 90%, the efficiency standard set for any cogeneration facility is as under:

The sum of useful power output and one half the useful thermal output be greater than 45% of the facility s energy consumption.

b) Using Liquid Fuel

Assuming that the achievable thermal efficiency for power generation using liquid fuel based combined cycle power generation system is about 50% while the boiler efficiency for steam generation observed in Indian industries is about 85-90%, the efficiency standard set for any cogeneration facility is as under:

The sum of useful power output and the useful thermal output be greater than 65% of the facility s energy consumption.

c) Refinery Bottoms as fuels

Refinery Bottoms or those by products of refining process would be permitted to be used as fuel for cogeneration facilities to be set up by any petroleum refining unit which can not be easily marketed due to transportation problems or due to low heat content. However, to qualify as a cogeneration plant, the sum of useful power output and one half the useful thermal output be greater than 45% of the facility s energy consumption. And in any calendar year, not less than 90% of the total heat input for the facility should come from refinery residue or the refinery bottom.

(II) Qualifying Requirements for Bottoming Cycle

In case of bottoming cycle, the total useful power out put in any calendar year must not be less than 50% of the total heat input through supplementary firing.

❖ **TARIFF FIXATION**

- While fixing tariff from a cogeneration plant, the basic consideration would be to share the benefits of higher efficiency. In addition, the other advantage available to the industry is availability of assured supply of power and possibly at a tariff lower than what the SEBs normally charge from their industrial consumers due to cross subsidization. On the other hand SEBs also stand to benefit from the fact that they qet surplus power at a rate lower than the marginal cost. However, in the bargain SEBs would have to let go some of their good customers. The tariff should, therefore, reflect these issues.
- The tariff can be fixed by the SEB by making adjustments for the higher efficiency and applying the same on the marginal cost of generation. Accordingly, the SEB can notify an acceptable tariff, reflecting the modified marginal cost of generation and pay at that rate for the life of the plant barring major fuel price escalations.
- Alternatively, the SEBs may chose to notify the first year tariff in two parts, fixed and variable, and announce an tariff escalation formula considering the fact that with the servicing of debt, recovered through depreciation, the fixed cost component comes down every year and at the same time the fuel cost increases due to fuel escalation.
- However, realizing the fact that ultimately the power sector would be required to move away from the cost based tariff structure, to get the full benefits we can probably use cogeneration plants for this switch over as even if there is slight error in fixing of the marginal tariff the damage would be very limited and can be corrected quickly in the subsequent cogeneration plants. This would also provide useful bench marks for other major IPPs.
- In case of topping cycle plants using refinery bottom as fuel, the tariff would be fixed by

the SEB on negotiated basis, providing for recovery of fixed costs of the power generating facility and the variable cost which could be determined by making adjustments for efficiency factors and other operational factors. Typically, the tariff for such plants may be represented by

Tariff = FCC + 0.8*Variable cost

❖ . **PROCEDURE FOR OBTAINING QUALIFYING STATUS**

The Qualifying Status to any facility would be granted by the State Government. The power producer would be required to submit the necessary documents to the State Government/SEB to establish fulfillment of the qualifying requirements in terms of efficiency criterion, choice of fuel, power generation technology and the stages of heat absorption in the industry.

❖ **GENERATION SCHEDULE**

As the availability of surplus power to be fed into the State grid will vary during the day depending on the operating cycle of the industry and may also vary with season if the industrial operations are season specific such as sugar mills etc. the power producer and the SEB/State Government would be required to mutually work out the schedule for power supply to the grid considering the industry and grid requirements.

4.4 SOME OF CAPTIVE THERMAL POWER PLANTS AND STATISTIC

TABLE 11: COMMISSIONED COAL FIRED THERMAL POWER PLANT

Coal Fired Thermal Power Plants: Commissioned

Sn.	Name of Client	Capacity in MW	Pressure and Temperature	Fuel	Location
1.	Grasim Industries Limited	12.5	66 kg + 485° C	Coal, Pet Coke, Lignite	Ariyalur
2.	Jaiprakash Associates Limited	1 x 27	86 kg + 515° C	Coal	CPP-I, Rewa
3.	Jaiprakash Associates Limited	1 x 27	86 kg + 515° C	Coal	CPP-II, Rewa
4.	Chettinad Cement Corpn. Ltd.	1 x 15	86 kg + 515° C	Coal + Lignite	Karikkali
5.	DCM Shriram Fertilisers Ltd.	1 x 40	86 kg + 515° C	Coal + Lignite	Kota
6.	OCL India Limited (Sponge Iron)	1 x 17	66 kg + 485° C	Coal + WH from sponge	Rajgangpur
7.	Jaiprakash Associates Limited	1 x 38.5	86 kg + 515° C	Washery reject	CPP-III, Rewa
8.	DCM Shriram Fertilisers Ltd.,	1 x 22	86 kg + 515° C	Coal	Ajbapur
9.	Mangalam Cement Limited	1 x 17.5	86 kg + 515° C	Coal	Morak
10.	Vasavadutta Cement Limited	1 x 17.5	66 kg + 485° C	Coal	A.P
11.	Dalmia Cement (B) Ltd, Ariyalur	1 x 27	95 kg + 540° C	Coal, Lignite	Ariyalur
12.	DCM Shriram	1 x 25	66 kg + 485° C	Coal	Ajbapur
13.	Grasim Industries Limited	2 x 23	95 kg + 540° C	Pet Coke, Coal	Kotputli

Sn.	Name of Client	Capacity in MW	Pressure and Temperature	Fuel	Location
14.	Sanghi Industries Limited	1 x 63	95 kg + 540° C	Coal, Pet Coke	Sanghipuram
15.	Binani Cement Limited	2 x 23	86 kg + 515° C	Coal & Lignite	Rajasthan
16.	Jaiprakash Associates Limited	1 x 38	86 kg + 515° C	Coal	Chunar
17.	Jaiprakash Associates Limited	1 x 27	86 kg + 515° C	Coal	Dalla
18.	Jaiprakash Associates Limited	1 x 35	86 kg + 515° C	Coal	Sidhi
19.	Jaiprakash Associates Limited	1 x 35	86 kg + 515° C	Coal + Lignite	Anjan
20.	Jaiprakash Associates Limited	1 x 25	86 kg + 515° C	Coal + Lignite	Bhuj
21.	Jaiprakash Associates Limited	1 x 25	86 kg + 515° C	Coal + Lignite	Wanakbori
22.	Mangalam Cement Unit – II	1 x 17.5	86 kg + 5150 C	Coal	Morak
23.	Jaiprakash Associates Limited	1 x 35	86 kg + 5150 C	Coal, Pet Coke	Balaji
24.	Jaiprakash Associates Limited	2 x 60	110 kg + 540° C	Coal, Pet Coke, Washery	Sidhi
25.	OCL India Limited	2 x 27	95 kg + 540° C	Washery Reject	Rajgangpur
26.	KJS Cement	1 x 27	86 kg + 515° C	Coal	M.P.

TABLE 12: UNDER EXECUTION COAL FIRED THERMAL POWER PLANT

Coal Fired Thermal Power Plants: Under Execution

Sn.	Name of Client	Capacity in MW	Pressure and Temperature	Fuel	Location
1.	Jaiprakash Associates Limited	3 x 60	110 kg + 540° C	Coal, Washery	Churk
2.	Siddhi Vinayak Cement Limited	1 x 30	110 kg + 540° C	Coal, Lignite	Rajasthan
3.	ABG Cement Limited	4 x 25	86 kg + 515° C	Lignite, Coal	Kutch & Surat
4.	UltraTech Cement Limited	1 x 30	110 kg + 540° C	Coal	Rawan
5.	UltraTech Cement Limited	2 x 25	110 kg + 540° C	Coal	Rajashree
6.	UltraTech Cement Limited	2 x 25	110 kg + 540° C	Coal	Tadipatri
7.	Jaiprakash Associates Ltd.	1 x 60	110 kg + 540° C	Coal	Shahabad
8.	Orient Cement Co.	2 x 20	110 kg + 540° C	Coal	Chittapur
9.	Jaypee Cement Corpn Ltd.	1 x 27	86 kg + 485° C	Coal	A.P.

TABLE 13: WASTE HEAT RECOVERY BASED POWER PLANT

Waste Heat Recovery based Power Plants

Sn.	Name of Client	Capacity in MW	Fuel	Location
1.	Union Cement Co.	1 x 14.7	Flue gas from Kiln and Cooler	UAE
2.	UltraTech Cement Limited	1 x 15.2	Flue gas from Kiln and Cooler	Rawan
3.	UltraTech Cement Limited	1 x 10.7	Flue gas from Kiln and Cooler	Rajashree New Line
4.	UltraTech Cement Limited	1 x 13.22	Flue gas from Kiln and Cooler	Awarpur
5.	UltraTech Cement Limited	1 x 10.04	Flue gas from Kiln and Cooler	Aditya
6.	UltraTech Cement Limited	1 x 7.3	Flue gas from Kiln and Cooler	Jafrabad
7.	UltraTech Cement Limited	1 x 12.5	Flue gas from Kiln and Cooler	Hirmi
8.	UltraTech Cement Limited	1 x 12	Flue gas from Kiln and Cooler	Rajashree Existing Line
9.	Ambuja Cement Limited	1 x 6	Flue gas from Kiln and Cooler	Rabriyawas
10.	Chettinad Cement Corpn. Limited	1 x 7.5	Flue gas from Kiln and Cooler	Karur
11.	Atbara Cement Company	1 x 9	Flue gas from Kiln and Cooler	Sudan
12.	Najan Cement Company	1 x 27	Flue gas from Kiln and Cooler + DG	Najran
13.	Sidhi Vinayak Cement Ltd. (NIRMA)	1 x 4.75	Flue gas from Kiln and Cooler	Rajasthan
14.	Heidelberg Cement India Ltd	1 x 12.7	Flue gas from Kiln and Cooler	M.P.
15.	Reliance Cementation Private Ltd	1 x 10.8	Flue gas from Kiln and Cooler	Rajasthan
16.	City Cement Co.	1 x 14.7	Flue gas from Kiln and Cooler	Riyadh
17.	Aditya Cement Line – II	1 x 6.3	Flue gas from Kiln and Cooler	Karnataka
18.	Eastern Province Cement Co.	1 x 21.0	Flue gas from Kiln and Cooler	KSA

TABLE 14: DG/GAS BASED POWER PLANT

DG / Gas based Captive Power Plants: Commissioned

Sn.	Name of Client	Capacity in MW	Fuel	Location
1.	Jaypee Cement Limited	1 x 30	HFO	Rewa
2.	Grasim Industries Limited	1 x 18	HFO	Kotputli
3.	City Cement Limited	1 x 39	LDO	KSA
4.	Najran Cement Limited	1 x 57	HFO	KSA
5.	Riyadh Cement Co.	1 x 30	LDO	KSA
6.	Gujarat Sidhee Cement Limited	1 x 20	HFO	Sidheegram
7.	DG set at Satna, JAL	1 x 7.5	LDO	MP
8.	DG set at Bagheri, JAL	1 x 6.0	LDO	HP
9.	Saudi Cement Company (GT)	3 x 38.5	Gas, Oil, Crude	KSA

Sn.	Name of Client	Capacity in MW	Fuel	Location
10.	Unicem Cement	3 x 18	Gas + HFO	Nigeria
11.	Al Safwa	6 x 7.5	HFO	KSA
12.	Jaiprakash Associates Ltd	10 x 12	HFO	At various locations
13.	Arabian Yemen Cement Co.	1 x 35	HFO	Yemen
14.	NRCC	1 x 49	HFO	Saudi Arabia
15.	DG set at Baga & Balaji, JAL	1 x 30	LDO	Baga & Bagheri
16.	DG set at Sikenderabad	1 x 12.5	HFO	Sikenderabad
17.	DG set at Chunar	1 x 12.5	HFO	Chunar
18.	DG set at Jaypee super	1 x 10.5	HFO	Dalla

4.5 : HARNESSING OF CAPTIVE GENERATION

Harness meanings is control and make use of (natural resources), especially to produce energy. Captive power plants (CPPs) have been installed by many industries and commercial establishments all over the country, and Captive Generation Capacity in Industries having demand of 1 MW or above, Grid interactive (as on 31-03-2011)=34444.12 MW Many of these plants have been set up to serve as standby sources of power (to run critical parts / services of the respective industrial unit / commercial establishment when grid supply fails or is cut off), and are, therefore, idling for considerable lengths of time.

The liberal provision in the Electricity Act, 2003 with respect to setting up of captive power plant has been made with a view to not only securing reliable, quality and cost effective power but also to facilitate creation of employment opportunities through speedy and efficient growth of industry.

The provision relating to captive power plants to be set up by group of consumers is primarily aimed at enabling small and medium industries or other consumers that may not individually be in a position to set up plant of optimal size in a cost effective manner. It needs to be noted that efficient expansion of small and medium industries across the country would lead to creation of enormous employment opportunities.

A large number of captive and standby generating stations in India have surplus capacity that could be supplied to the grid continuously or during certain time periods. These plants offer a sizeable and potentially competitive capacity that could be harnessed for meeting demand for power. Under the Act, captive generators have access to licensees and would get access to consumers who are allowed open access. Grid inter-connections for captive generators shall be facilitated as per section 30 of the Act. This should be done on priority basis to enable captive generation to become available as distributed generation along the grid. Towards this end, non-conventional energy sources including co-generation could also play a role. Appropriate commercial arrangements would need to be instituted between licensees and the captive generators for harnessing of spare capacity energy from captive power plants. The appropriate Regulatory Commission shall exercise regulatory oversight on such commercial arrangements between captive generators and licensees and determine tariffs when a licensee is the off-taker of power from captive plant.

Many other CPPs also operate on part - load for long durations, and have spare capacity. However, since these plants have been established primarily for self - use, in most cases, there is no structured commercial arrangement in place between CPP owners and host utilities to facilitate injection of the idling / spare capacity into the grid.
All regions of the country presently suffer from serious peak-hour shortages and load-shedding / rostering has to be resorted to. With the continued growth of consumer demand, and slow pace of generating capacity augmentation, the demand - supply gap is likely to persist for many years to come. This gap could be quickly bridged, at least partly, by harnessing the existing Captive generation.

The dominant share of the metals and minerals industry, which mostly uses coal, states like Chhattisgarh and ORISSA together account for a major part of the capacity, followed by West Bengal.

a) Quantum of surplus power available from a CPP for feeding into the grid would most often be uncertain. Since the primary objective of the CPP installation is to support the associated industry, any increase in the industry"s load and / or any decrease in CPP availability would automatically bring down the power availability for the grid (which would be the second priority here). As a consequence, the CPP may not be in a position to supply power to a utility / licensee on a committed basis. In other words, the CPPs would not be able to supply power as per a firm schedule, but only on "as-and-when-available" basis. The concerned utility / licensee would generally be unwilling to pay a remunerative tariff for such infirm power.

b) In many cases, power supply to the industries / commercial establishments is cut off during peak-load hours (as a regular rostering measure to restrict the State"s over-drawl from the regional grid), and these industries / establishments have to run their Captive generation during such hours for continued operation. What this means is that availability of Captive generation for feeding power back into the grid would be much lower during peak hours (when its support is needed the most) and comparatively higher during off-peak hours (when the utility / licensee may be able to meet its own requirement with power available from other sources).

c) Due to their smaller size and use of costly fuel, cost of generation at CPPs would generally be comparatively higher. On the other hand, the utility / licensee would be reluctant to pay to CPPs a price higher than what it pays for bulk supply on contracted basis from regular generating stations, particularly when the CPP power is of comparatively low reliability and low peak-hour availability. Consequently the price that a utility / licensee may be prepared to pay to a CPP on a contracted basis may not even cover the variable cost of the CPP.

Due to the above, it is very likely that the SERCs, in spite of their best intentions and efforts, may not be able to arrive at a tariff (based on the conventional tariff determination principles) which is acceptable to both the parties. Under such a situation, the following approach may be

adopted as a viable alternative, for harnessing the available idling / surplus capacity of the CPPs.
Harnessing the surplus power from the Captive Power Plants has the following advantages:

- Partially bridge the gap between Demand & Supply.
- Optimize the investment made in CPPs
- Improve the efficiency of CPPs by operating at a higher PLF (Plant Load Factor).
- Additional revenues could be generated by the CPPs by sale of surplus power

The energy as well as peaking shortages across the country is a matter of concern and the situation would have been worse but for the slowdown in manufacturing sector.

4.6 OPEN ACCESS IN CAPTIVE POWER PLANT

According to electricity Act 2003 a Captive generator can avail open access for the purpose of transmitting electricity from the Captive Power Plant to the destination of its own use however the availability of adequate transmission facility is to be determined by Central Transmission Utility or State Transmission Utility. Any dispute regarding the availability of Transmission facility should be dealt by the appropriate Commission. Section 40 and Section 42(2) of Electricity Act 2003 deals with Duties of Transmission & Distribution Licensee respectively, states that the surcharge is to be levied on the consumer under open access and such surcharge is to be used to meet current level cross subsidy. Such surcharge is not levied in case open access is provided to a person who has established a captive generating plant for carrying the electricity to the destination of his own use.

In the context of competition, open access is the corner-stone of the Act. Open Access has been conceived as an important tool of introducing competition in the electricity industry and ensuring choice to buyers and suppliers of electricity.
The Act envisages Open Access in transmission and distribution network. Open Access in transmission has been allowed from the very beginning and without any fetter. However, in so far as Open Access in distribution is concerned, the law envisages introduction of such Open Access in phases with due consideration of the operational constraints and existence of cross subsidy between consumer categories.
This responsibility of phased introduction of open access in distribution has been bestowed on State Electricity Regulatory Commissions. Through an amendment in the Act, it has, however been provided that the State Commissions shall provide by January, 2009 open access to all consumers with load exceeding 1 MW. The issue of open access for consumers with load exceeding 1 MW has been under discussion in recent past in view of the various interpretations floated in the context. The Government of India (Ministry of Power and Ministry of Law) in its latest interpretation on 30.11.2011 has articulated that Section 42 of the Act makes it mandatory

for all consumers with load exceeding 1 MW to be open access consumers and that the tariffs for such consumers shall not be regulated by SERCs.

Even as the central government is pushing state for mandatory implementation of Open Access (OA) for bulk power consumers, an analysis by a regulators body has revealed that contrary to expectations, the consumers in 12 states have had to pay more for power under the new regime. Open Access at various levels is the hallmark of electricity reforms and the regime has been effective in 20 states since January 2009 on an optional basis. Under the Open Access regime, bulk consumers enter into bilateral deals with discoms and stay outside the ambit of the regulated tariff system.

➢ OPEN ACCESS FOR CAPTIVE POWER GENERATION

- **Sec. 9(2)** : Captive Generating Plant shall have right to have open access for the purpose of carrying electricity from Captive Generation Plant to destination of his use.
- **Section 38(2)(d)** : In case of Central Transmission System, surcharge shall not be leviable in case of open access is provided to Captive Generating plant for carrying electricity to destination of his use.
- **Section 39(2)(d)** : In case of State Transmission System, surcharge shall not be leviable in case of open access is provided to Captive Generation plant for carrying electricity to destination of his use.
- **Section 42(2)** : For use of Distribution System, surcharge shall not be leviable in case open access is provided to a CPP for carrying electricity to destination of his use.

➢ CATEGORIZATION OF OPEN ACCESS

On the basis of location of buying and selling entity, the open access is categorized as:

- **INTER STATE OPEN ACCESS:**

When buying and selling entity belongs to different states. In this case CERC regulations are followed. It is further categorized as:

1. Short Term Open Access (STOA): open access allowed for the period of less than one month.
2. Medium Term Open Access (MTOA): open access allowed for a period of 3 months to 3 years.
3. Long Term Open Access (LTOA): open access allowed for a period of 12 years to 25 years.

** If suppose you require open access for two months, then you should re – apply for STOA before the expiry of first month.

- **INTRA STATE OPEN ACCESS:**

When buying and selling entity belongs to same state. In this case SERC regulations are followed. It is further categorized as STOA, MTOA, and LTOA and the duration of which depends on the respective state open access regulations.

➢ **TYPES OF TRANSACTIONS:**

In general the buyer and seller of electricity can go for **bilateral or collective transactions**. In bilateral transactions a PPA is signed between the buyer and seller, which is generally facilitated by a trader for a little margin. In case of collective transactions the electricity is traded through exchanges, by exchange members for a very small margin fixed by commission. Currently India has two exchanges PXIL and IEX.

➢ **OPEN ACCESS CHARGES:**

There are several charges to be paid by open access consumers to distribution licensee, transmission licensees and other related entities, other than the power purchase cost paid to the generator or supplying entity. These charges include:

- Connectivity Charges
- PoC Charges
- Transmission Charges
- Transmission Losses
- Wheeling Charges
- Wheeling Losses
- Cross Subsidy Surcharge
- SLDC Charges
- RLDC Charges

** In addition to these charges the open access consumers has also to fulfil the renewable purchase obligation (RPO), in which they have to purchase a part of their total consumption through electricity generated from renewable energy.

4.7 SALE OF POWER THROUGH SHORT TERM MARKET TRANSACTIONS

Short-term transactions of electricity" refers to the contracts of less than one year period, for electricity transacted (inter-state & intra-state) through Inter-State Trading Licensees and directly by the Distribution Licensees, Power Exchanges (Indian Energy Exchange Ltd (IEX) and Power Exchange India Ltd (PXIL)), and Unscheduled Interchange (UI).
The objectives are:

(i) To observe the trends in volume and price of the short-term transactions of electricity; (

(ii) To analysis competition among the market players;

(iii) To analysis effect of congestion on volume of electricity transacted through power exchanges;

(iv) To provide information on volume and price of Renewable Energy Certificates (RECs) transacted through power exchanges; and (v) to disclose/disseminate all relevant market information.

Short Term Transactions could be electricity transacted under

* Bilateral Transactions (either direct or through trader)
* Energy Exchanges
* Unscheduled Interchange (UI) (not a market mechanism but considered under short term transactions)

4.7.1 VOLUME OF SHORT-TERM TRANSACTIONS OF ELECTRICITY

During the month of March 2015, total electricity generation excluding generation from renewable and captive power plants in India was 86337.81 MUs (Table-16).

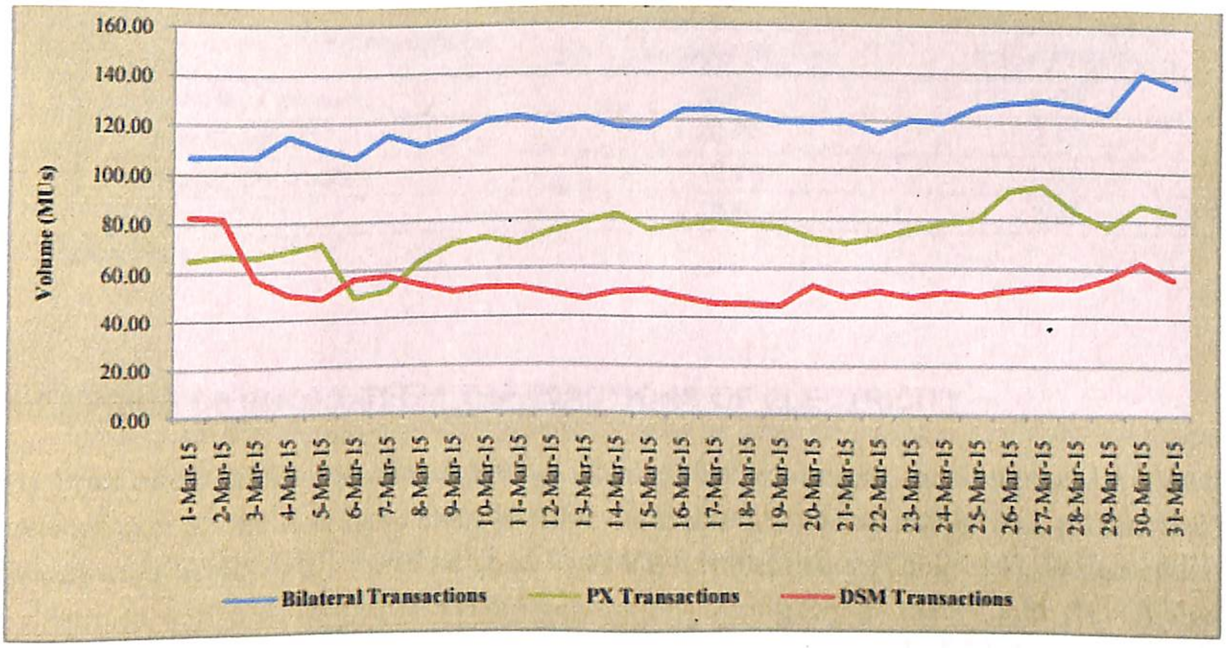
TABLE 16: VOLUME OF SHORT-TERM TRANSACTIONS OF ELECTRICITY ALL INDIA IN MARCH 2015

Sr.No	Short-term transactions	Volume (MUs)	% to Volume of short-term transactions	% to Total Generation
1	Bilateral	3710.28	48.37	4.30
	(i) Through Traders and PXs	*2435.21*	31.75	2.82
	(ii) Direct	*1275.07*	16.62	1.48
2	Through Power Exchanges	2304.54	30.04	2.67
	(i) IEX	*2276.76*	29.68	2.64
	(ii) PXIL	*27.78*	0.36	0.03
3	Through DSM	1656.08	21.59	1.92
	Total	**7670.91**	**100.00**	**8.88**
	Total Generation	**86337.81**	--	--

Source: NLDC

Of the total electricity generation, 7670.91 MUs (8.88%) were transacted through short-term, comprising of 3710.28 MUs (4.30%) through bilateral (through traders and term ahead contracts on power exchanges and directly between distribution companies), followed by 2304.54 MUs (2.67%) through day ahead collective transactions on power exchanges (IEX and PXIL) and 1656.08 MUs (1.92%) through DSM (Table-1 & Figure-2).Of the total short-term transactions, bilateral constitutes 48.37% (31.75% through traders and term-ahead contracts on power exchanges and 16.62% directly between distribution companies) followed by 30.04% through day ahead collective transactions on power exchanges and 21.59% through DSM (Table-16). Daily volume of short term transactions is shown in Figure-26.

FIG 26:VOLUME OF SHORT-TERM TRANSACTIONS OF ELECTRICITY IN MARCH 2015(DAY WISE).



The volume of electricity transacted through IEX and PXIL in the day ahead market was 2276.76 MUs and 27.78 MUs respectively. The volume of total buy bids and sale bids was 3164.93 MUs and 3935.27 MUs respectively in IEX and while the same was 62.48 MUs and 100.18 MUs respectively in PXIL. The gap between the volume of buy bids and sale bids placed through power exchanges shows that there was lesser demand in both IEX (0.80 times) and PXIL (0.62 times) when compared with the supply offered through these exchanges.
The volume of electricity transacted through IEX and PXIL in the term-ahead market was 7.47 MUs and 39.63 MUs respectively (Table-17 & Table-18).

Table 17:VOLUME AND PRICE OF ELECTRICITY IN TERM AHEAD MARKET OF IEX, MARCH 2015

Sr.No	Term ahead contracts	Actual Scheduled Volume (MUs)	Weighted Average Price (₹/kWh)
1	Intra-Day Contracts	7.47	3.34
	Total	**7.47**	**3.34**

Source: IEX

Table 18 : VOLUME AND PRICE OF ELECTRICITY IN TERM AHEAD MARKET OF PXIL,MARCH 2015

Sr.No	Term ahead contracts	Actual Scheduled Volume (MUs)	Weighted Average Price (₹/kWh)
1	Intra-Day Contracts	0.75	4.00
2	Daily Contracts	26.88	2.45
3	Weekly Contracts	12.00	2.13
	Total	**39.63**	**2.38**

Source: PXIL

4.7.2 PRICE OF SHORT-TERM TRANSACTIONS OF ELECTRICITY

(i) Price of electricity transacted through Traders: The minimum, maximum and weighted average sale prices have been computed for the electricity transacted through traders and the sale prices were `2.92/kWh, `7.99/kWh and `4.49/kWh respectively (Table- 19). Weighted average sale prices were also computed for the transactions during Round the 8 Clock (RTC), Peak, and Off-Peak periods separately, and the sale prices were `4.57/kWh,`4.08/kWh and `3.34/kWh respectively (Table 20).

TABLE 19:PRICE OF ELECTRICITY TRANSACTED THROUGH TRADERS, MARCH 2015

Sr.No		Sale Price of Traders (₹/kWh)
1	Minimum	2.92
2	Maximum	7.99
3	Weighted Average	4.49

Source: Information submitted by trading licensees

TABLE 20:PRICE OF ELECTRICITY TRANSACTED THROUGH TRADERS (TIME-WISE),MARCH 2015

Sr.No	Period of Trade	Sale Price of Traders (₹/kWh)
1	RTC	4.57
2	PEAK	4.08
3	OFF PEAK	3.34

Source: Information submitted by trading licensees

(ii) Price of electricity transacted Through Power Exchanges: The minimum, maximum and weighted average prices have been computed for the electricity transacted through IEX and PXIL separately. The minimum, maximum and weighted average prices were `0.80/kWh, `20.00/kWh and `2.78/kWh respectively in IEX and `1.00/kWh,`4.01/kWh and `2.65/kWh respectively in PXIL (Table-21).

TABLE 21:PRICE OF ELECTRICITY TRANSACTED THROUGH POWER EXCHANGES,MARCH 2015

Sr.No	ACP	Price in IEX (₹/kWh)	Price in PXIL (₹/kWh)
1	Minimum	0.80	1.00
2	Maximum	20.00	4.01
3	Weighted Average	2.78	2.65

Source: Information submitted by IEX and PXIL

The price of electricity transacted through IEX and PXIL in the term-ahead market was `3.34/kWh and `2.38/kWh respectively (Table-17 and Table-18).

(iii) Price of electricity transacted through DSM: The average deviation price was `1.87/kWh for all India grid. The minimum and maximum deviation prices were `0.00/kWh and `8.24/kWh respectively in the all India grid (Table-22).

TABLE 22 PRICE OF ELECTRICITY TRANSACTED THROUGH DSM, MARCH 2015

Sr.No		Price in All India Grid (₹/kWh)
1	Minimum	0.00
2	Maximum	8.24
3	Average	1.87

Source: NLDC

The prices of electricity transacted through trading licensees, power exchanges and DSM and their comparison is shown in Figure-27 & 28.

FIG 27 : PRICE OF SHORT-TERM TRANSACTIONS OF ELECTRICITY, MARCH 2015

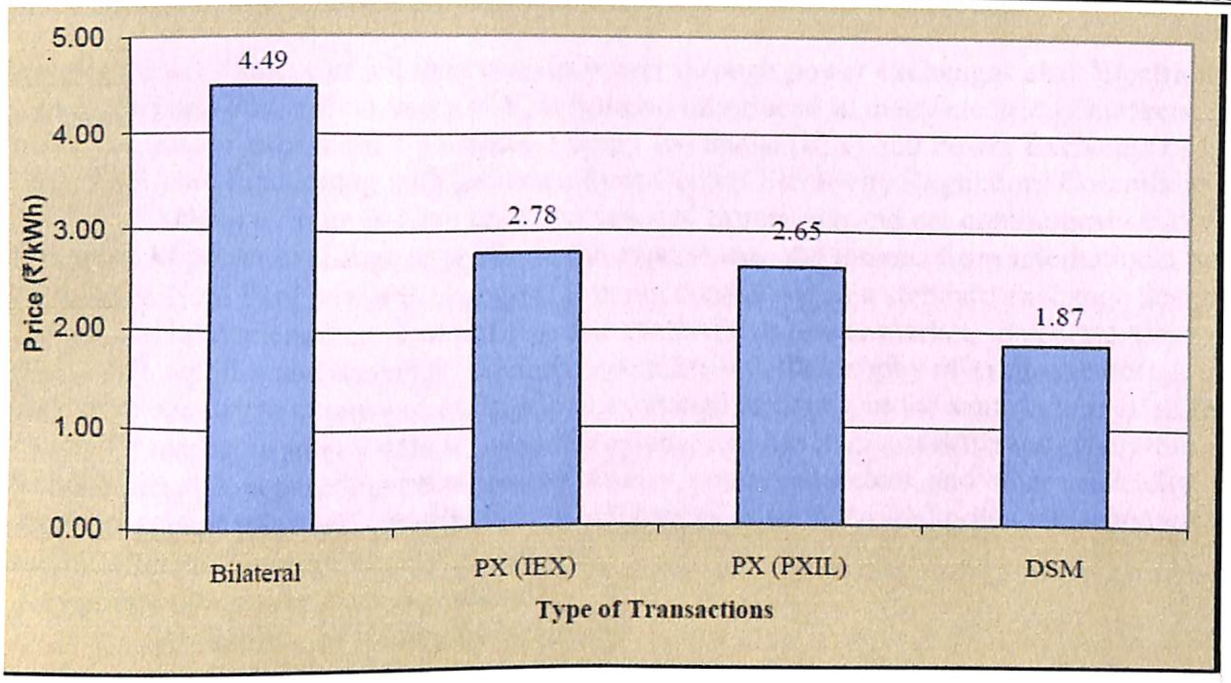
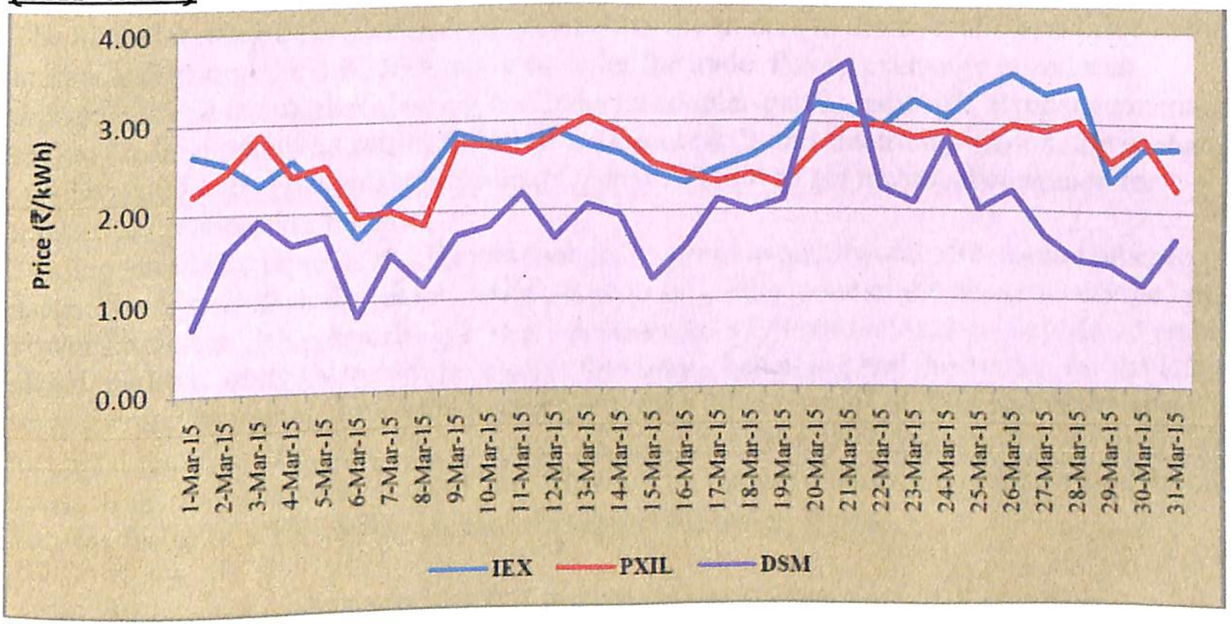


FIG 28 : PRICE OF SHORT-TERM TRANSACTIONS OF ELECTRICITY, MARCH 2015 (DAY-WISE)



4.8 SALE OF SURPLUS POWER THROUGH POWER EXCHANGE

Captive Power Plants can sell their surplus power through power exchanges also. Electricity trading through Power Exchanges (PX) is hitherto introduced in many electricity markets. In India, two power exchanges viz., Indian Energy Exchange (IEX) and Power Exchange of India Ltd. (PXIL) are functioning with guidance from Central Electricity Regulatory Commission (CERC). Exchanges in India have only two years of experience and are continuously evolving. Evolution of power exchange depends on the experiences and lessons from international power exchanges. Nord Pool power exchange () is being considered as a standard exchange design. Design and implementation issues of a power exchange or power market, in general, depend on the market supplies and demands, liquidity, economy etc. Philosophy of exchange design may vary from country to country or exchange to exchange (working in the same country). In India, electricity market is supply deficit (in some regions) and has a mix of different generation technologies. PX is a trading center where utilities, power marketers, and other electricity suppliers submit price and quantity bids to sell energy or services, and potential customers submit offers to purchase energy or services.

Key points of a power exchange include:

- facility for trading of electricity
- foster the development of competition
- transparency
- liquidity

The idea of trading through an exchange enables the traders to discover the best price in the market and to find the optimum buyer or seller for trade. Power exchange introduces transparency in the market clearing and reduces counter-party credit risk. Exchange manages trades, clears market and settles financial transactions. In the electricity market, the exchange is synchronized with Transmission System Operator (TSO) to get technical clearance for transacting power over the grid.

Trading should be done in an efficient manner to provide quality and affordable power to end users. Power exchange formation could prove to be a mile stone in the above mentioned purpose Power Exchange (PX) directly operates wholesale energy markets, such as day-ahead and hour-ahead markets, while the real-time market for energy balancing and the market for the ancillary services may be operated directly by the TSO or by PX on behalf of TSO and under specific technical requirements. The TSO controls and operates the transmission grid and facilitates transactions and transmission avoiding influence on the generation schedules created by the PX. Success factor of a PX can be measured with the following inputs:

- Number of participants in PX -Liquidity in the market
- Market growth in terms of traded volume -Competitiveness of fee structure .

4.8.1 INDIAN ENERGY EXCHANGE

BROAD FEATURES

The broad features of power Exchange are given below.

- Approved and Regulated by Central Electricity Regulatory Commission
- Nationwide, Online and Electronic platform
- Voluntary participation.
- Neutral, Unbiased and Transparent
- Offer Market for Electricity, Renewable Energy Certificates, Energy Efficiency Certificates, etc.
- Exchange time-line consistent with time-line of Load Dispatch Centre
- The activities of the Exchange are carried out in accordance with the "Central Electricity Regulatory Commission (Power Market) Regulations, 2010, dated 20th January 2011", "Central Electricity Regulatory Commission (Open Access in inter-State Transmission) Regulations, 2008", dated 25.01.2008, as revised from time to time and Procedure for scheduling of collective transaction issued by the Central Transmission Utility (PGCIL) and the Bye-Laws, Rules and Business Rules of the Exchange. The Exchange shall offer products for different time horizons so as to offer total solution to the market participants. Honorable Commission has desired the Exchange be a market based institution. We propose to add variety in terms of products offered and method of bid-matching process and would evolve corresponding rules, bye-laws for clearing, settlement, margins, deposits, market surveillance etc.

IEX Day-Ahead Market

On a daily basis the Exchange will offer a double side closed auction for delivery on the following day, which is termed as day-ahead market. Price discovery would be through double side bidding and buyers and suppliers shall pay/receive uniform price. Day Ahead Market operations will be carried out in accordance with the 'Procedure for scheduling of collective transactions' issued by the Central Transmission Utility (PGCIL), 'CERC (Open Access in inter-State Transmission) Regulations, 2008' ,its modifications issued from time to time and the Bye-Laws, Rules and Business Rules of the Exchang

✓ Process of Closed-Bidding Auction

(a) **Bid accumulation period (Bidding phase)**

During the auction sessions on each Trading Day, bids entered by Members on the IEX Trading Platform are automatically stored in the Central Order Book without giving rise to Contracts. During this phase, bids entered can be revised or cancelled. Bid accumulation period shall start at 10.00 AM and will end at 12.00 Noon.

(b) Auction period

At the end of the bidding session, the IEX Trading Platform will seek to match bids for each 15 minute time block. After the price determination phase is concluded, the Members, whose bids have been partially or fully executed, will be provided all relevant trade information regarding each contract traded on the IEX Trading Platform.

(c) Price Determination Process (Provisional)

All purchase bids and sale offers will be aggregated in the unconstrained scenario. The aggregate supply and demand curves will be drawn on Price-Quantity axes. The intersection point of the two curves will give Market Clearing Price (MCP) and Market Clearing Volume (MCV) corresponding to price and quantity of the intersection point. Results from the process will be preliminary results. Based on these results the Exchange will work out provisional obligation and provisional power flow. Funds available in the settlement account of the Members shall be checked with the Clearing Banks and also requisition for capacity allocation shall be sent to the NLDC. In case sufficient funds are not available in the settlement account of the Member then his bid (s) will be deleted from further evaluation procedure.

(d) Price Determination Process (Final)

Based on the transmission capacity reserved for the Exchange by the NLDC on day ahead basis by 2.00 PM, fresh iteration shall be run at 2.30 PM and final Market Clearing Price and Volume as well as Area Clearing Price and Volume shall be determined. These Area Clearing Prices shall be used for settlement of the contracts.

(e) Settlement

On receipt of final results, obligations shall be sent to Banks for Pay In from buying Members at 2.30 PM and will take confirmation of the same from the Bank. At 3.00 PM final results will be sent to NLDC / SLDCs for incorporating in final schedules. Once a transaction is scheduled it shall be considered as deemed delivery.

- **DAY-AHEAD MARKET**

- **DELIVERY POINT**

Delivery point for the purpose of contract, shall be reckoned as the periphery of Regional Transmission System in which the grid-connected exchange entity is located. The same shall be used for the purpose of payment of transmission charges in cash and transmission losses in kind. For example, delivery point for a state -embedded entity in Maharashtra shall be WR periphery.

- **Day-ahead Scheduling of Exchange traded contracts**

The Exchange traded contracts will be aggregated for each region and State for each hour. This will also give net contractual flows between regions and/or bid areas. After the schedules are issued by NLDC/SLDCs, the delivery shall be deemed to have been completed.

- **Transmission Capacity, Transmission Charges and Losses**

(a) Levy of transmission charges

Following Transmission Charges shall be payable by the Members for the traded contracts:
Transmission Charges for respective Regional Transmission System, as made applicable under the Central Electricity Regulatory Commission (Open Access in inter-State Transmission) Regulations, 2008.
Transmission Charges for respective State Transmission Licensee, as decided by the concerned State Electricity Regulatory Commission.
In absence of any direction or order from concerned SERC, in this respect, the provisions as stipulated in the Central Electricity Regulatory Commission (Open Access in inter-State Transmission) Regulations, 2008 shall be applicable. Socialized Scheduling and Operating Charges for trades on the Exchange. The Exchange shall pay such charges based on Central Electricity Regulatory Commission (Open Access in inter -State Transmission) Regulations, 2008 to NLDC and SLDCs. Such charges shall be socialized over all transactions within respective State(s) and Region(s).Any other charges as specified by CERC.

(b) Transmission Losses:

All grid connected exchange entities shall pay, in kind, the transmission losses from delivery point to its grid connection point. Transmission losses, for the Regional Transmission System, as decided by the NLDC for Collective transactions, shall be accounted for at the time of scheduling. Similarly, transmission losses for the State Transmission Licensees, as prescribed by the respective SERC, shall also be accounted for at the time of scheduling.

- **Scheduling**

Selected trades sent to Nodal Agency i.e. RLDC of Buyer State after collecting SLDC clearance.
Scheduling Procedure as per Procedure for Scheduling of Bilateral Transaction, issued by CTU.
IEX files an application to the concerned RLDC.

- **Margins & Settlement**

Collect requisite margin before trading and delivery (Initial margin, additional margins, other margins)
Reservation of transmission capacity by Nodal RLDC. □
Issue of Schedules by concerned RLDCs on daily basis □
Financial Settlement by IEX □

❖ **Benefits:**

✓ **Transparency**

IEX offers a transparent, national-level platform for trading electricity in India leading to a vibrant power market.

✓ **Access a diversified portfolio**
IEX offers a broader choice to generators and distribution licensees at the national-level so that they can trade in smaller quantities and smaller number of hours without additional overheads.

✓ **Payment security**
IEX stand in as the counter-party for all trades; so participants need not be concerned about the risk-profile of the other party.

✓ **Minimal transaction overheads/charges**
All charges are displayed on the IEX trading terminals; so there is no room for negotiation. The cost of transactions through IEX is much less than any other mode of transaction.

✓ **Efficient portfolio management**
IEX enables participants to precisely adjust their portfolio as a function of consumption or generation. Participants, especially distribution licensees, are enabled to precisely manage their consumption and generation pattern.

✓ **Hedging UI risks**
IEX provides a tool to hedge against adverse movements in electricity prices. Thus, price risks are minimized.

✓ **Market development**
IEX has plans to launch a range of products to facilitate development of power markets in India in such a way that investment in capacity enhancement is encouraged.

BENEFITS TO CAPTIVES FROM THE EXCHANGE

- **Security against Defaults** – Financial mechanism where a Clearing House is responsible for settlements with Exchange as a counter party shall provide a credible settlement mechanism that insures sellers against defaults
- **Transmission capacity assignment** – Power Producers would not have to bother about getting Transmission capacity assigned over inter-regional power links (and getting it renewed every three months) as the Exchange shall be responsible for getting capacities allocated to successful transactions
- **Ease in Decision making** – Since it is difficult for both, Captive and Renewable Power Producers to make firm long term commitments for assured supply, clarity on quantum of power and the price at which it can be sold on a day ahead basis would facilitate decision making

4.9 ISSUES ,BENEFITS, CHALLAENGES & FORCAST.

Captive power today is significant source of power for the Indian economy, which plays an important role in the present power scenario being characterized by inadequate supply of power, poor and unreliable power quality, and high tariffs resulted due to heavy cross-subsidization. There is paradigm shift in usage pattern of captive power plants from back-up use to baseload use. Presently the captive power plants capacity accounts for nearly one-fifth of the total installed capacity. With liberalization of economy and technological developments many options are available for captive structuring.

4.9.1 IMPORTANCE OF CAPTIVE POWER PLANTS:-

1. Security of power supply through self-generation
2. Reduced costs through high fuel efficiency, particularly when in CHP configuration
3. Improved environmental performance resulting from fuel efficiency.

4.9.2 CONCERNS FOR CAPTIVE POWER :-

✓ While on the other hand the **CONCERN OF THE OWNERS** of captive and cogen plants stems from:

- Non-remunerative tariff structure for surplus power produced by them
- No risk sharing in case of no availability of fuel, change in variable cost due to switching of fuel after entering into power purchase agreement (PPA), etc.
- Inadequacies in wheeling and banking facilities
- High contract demand charges.
- High level of duties and taxes on sale of power .
- High wheeling losses assumed for power to be sold to grid by captive or cogen plant
- Need to devote time and energy to an activity, which is not their core business

- Restrictions on the minimum amount of power to be wheeled
- If the captive power plant (CPP) fails, charges for back-up or standby power from the grid are twice the normal rate for captive plants.
- No formal policy for purchase of cogenerated power (in most of the states) It is estimated that about 30% of the total energy requirement of the Indian industry is currently met through in house power plants

✓ **CONCERN FOR STATE ELECTRICITY BOARDS** on account of following reasons:
Captive plants may have adverse impacts on the finances of the utility, such as:

- Industrial load is the main source for cross-subsidizing revenue flows
- Billing and collection is much more efficient for HT consumers
- State electricity board's ability to service escrow accounts for security packages is also reduced
- Non-optimal growth of the sector
- Problems in grid management especially in case of states with surplus power
- Adverse environmental impacts arising from types of fuels used and from higher emissions per unit of production, as compared to large power plants
- Reliability of power supply from captive and cogeneration plants as a source of firm power

4.9.3 ISSUES:-

I. KEY ISSUES BEING FACED BY CAPTIVE POWER PRODUCERS

✓ **SUPPLIER CONSTRAINTS**

• Low flexibility to enter into long term fixed contracts

• Self-consumption of Captive owners has hourly and seasonal trends; Renewables such as Wind power producers cannot commit a firm supply. As a result, they are not in a position to assess the quantum of power that they would be able to trade on a long term basis

• Lack of robust Payment Security mechanisms that protects against defaults.

✓ **MARKET RELATED**

- Lack of an Institutionalized Power Trading Market that –
- Allows Buyers and Suppliers to discover each other
- Operates on a day ahead basis – Buyers and suppliers who do not have long term visibility find day ahead markets useful for their requirements
- Provides sufficient liquidity
- Hedges risks of both – Buyers and Suppliers
- Is affordable – low transaction costs

✓ **REGULATORY ISSUES**

- Open access related charges – High cross-subsidy surcharges, wheeling charges etc may render the Buyer's proposition of procuring external power non-viable
- High loss allocation (commercial losses also allocated)
- Tariff Related – No relaxation in contract demand for a Discom consumer who procures part of his power requirement from external sources may lead to loss of Load factor rebates
- Lack of standby support/ Disproportionate standby support charges
- Rate mandated for sale of power to Distribution Utility may be non-economical
- Short term transmission capacity allocation
- Grid support/parallel operation charges

✓ **TECHNICAL ISSUES**

- Grid connectivity issues
- Lack of a mechanism such as Intra-state ABT for UI settlement

✓ **OTHERS**

- Dismantling of transmission/distribution line on disconnection

- **Electricity (Amendment) Act Provision** – The amended Act, in force from June 15, 2007 provides that **no licence** shall be required for supply of electricity generated from a captive generating plant to any licence and to any consumer.

- Captive Power Producers are; therefore, free to sell surplus power to consumers/ licensees without the need for license

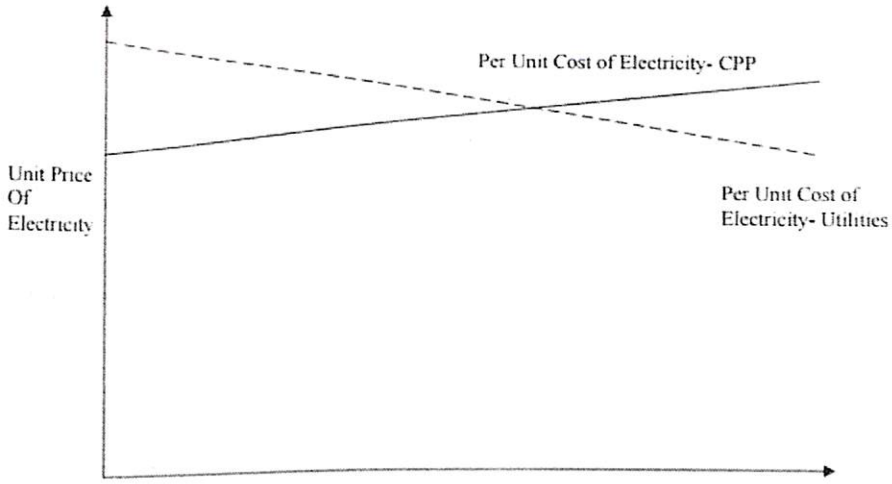
II. ISSUE RELATED TO CAPTIVE POWER:-

- For the industries that use energy intensively, the energy is the critical component of the total production cost.
- The engineering, chemical and mineral/metal industries account for almost two-thirds of the total installed capacity in the captive segment. Other industries include cement, textiles and sugar.
- The captive generator has a number of fuel options today. The choice could be between oil, natural gas, naphtha, bagasse or coal.There are also options like wind and hydro.
- Availability of open access is the major issue related to the selling of power to grid by captive power plants.
- Other issues are related to the strengthening of intra-state and inter-state transmission network, reasonable tariff and availability of available additional fuel required by the captive power plants.
- Installation of captive power plants in future is likely to grow at a higher rate compared to the current rate of growth. The promise for future growth of captive power plants lies with the renewable sources of energy. Fossil fuels are limited and have adverse environmental impact.

Captive demand, therefore, provides an attractive 'niche' for renewable energy to be deployed in industry. Industries also faces the dichotomy whether to install CPPs or not. One of the main risks that the industry is perceives is the regulatory risks, which might create the stranded asset problem for them. The states in India are undergoing electricity reforms. As a part of the reform process, the states have institutionalized regulatory bodies such as State Electricity Regulatory Commission (For example, in Gujarat, the Gujarat State Regulatory Commission). One of the objectives of these regulatory bodies is to rationalize the tariff. With the rationalization of the tariff structures, there is a possibility that the industrial tariffs become lower than the cost of generation of certain captive power plants. This can increase the payback period of the captive power plant by shifting the break- even point. Worse, it can make the whole investment uneconomical for the industry thus creating stranded assets (fig 29).

Fig 29

Impact of price shocks on smaller CPPs: A Conceptual Understanding



4.9.4 SOME FEATURES:

- Captive Power refers to generation from a unit set up by industry for its exclusive consumption.
- Captive power plants are essentially non utility power plants.
- These power plants are owned by specific industries which consume all the power produced for its production purposes.
- The size of these power plants varies. These power plants can be as small as 0.2 MW or can be as big as 300 MW.

The **major factors** responsible for the soaring growth of the captive power plants are, as follows:

- Non-availability of adequate grid supply
- Poor quality and reliability of grid supply
- High tariff as a result of heavy cross subsidization

4.9.5 BENEFITS:-

- Captive power plant is close to the load centre and hence reduction in the fixed cost of electricity generated due to lesser stranded assets
- Reduced transmission and distribution losses
- Grid is strengthened at multiple points, even at the tail-ends.
- Higher thermal efficiency, due to waste heat recovery by method of cogeneration
- Distribution of environmental impact
- Shorter gestation period to set up power plants

- Captive power plants have modular designs and hence can match the load profile

4.9.6 LIMITATIONS

- Transaction of power between CPP and grid depends on availability of open access. Thus the issues related to open access are
- The State Regulatory Commissions which have not issued the regulations for open access may have to expedite the process.
- The State Regulators may be urged to develop progressive and encouraging policies for CPP (like one issued by MERC)
- No electricity duty should be imposed on self consumption of electricity generated by Captive Power Plants of a industry. Reasonable duty may be imposed for sale of power.
- Reduction in contract demand of a CPP holder with distribution licensee may be allowed without any penalty.
- CPPs which are parallel with the grid, standby demand charges should be reasonable. However, if the CPP exceeds the Contract standby Demand then reasonable penal rate should be applicable on excess drawl.
- High wheeling charges & losses make open access unviable.As captive surplus would be sold within a limited area, wheeling charges / losses should be applied for the particular area rather than average grid charge / losses.
- Wheeling charges for transfer of surplus power may not exceed 7% of the generation cost within the state.
- The cross subsidy surcharge applicable on HT consumers opting to purchase surplus power from CPPs must be reasonable. This may be fixed in accordance with avoided cost method suggested by FOIR (Forum of Indian Regulators).
- For the purpose of recovery of T&D losses in OA charges, the losses should be benchmarked to reflect technical losses, gradually reduced and equitably distributed. Gradually recovery of commercial losses needs to be reduced
- Parallel Operation Charges (POC) imposed by state utility is very high. Aligning of POC with ABT regime would encourage connectivity to grid for facilitating transfer of surplus power to the licensee.
- Banking of energy may be allowed by the distribution licensee and shall be regulated by the energy banking agreement.
- For Continuous Process Industry round the clock banking should be permitted with a rider that energy banked at night should be drawn during the night hours only.
- For the present, 0. 5 class metering arrangement may be allowed. 0.2 class accuracy metering arrangement as required as metering regulations may be installed in phases.
- Imposition of cess on captive power generation.

- Strengthening of intra-state and inter-state transmission network.
- Fixation of reasonable tariff by State Regulatory Commission for the surplus power available from the CPPs.
- To make available additional fuel required by the CPPs.

Because of high fuel costs, the power generation cost from CPP is higher than grid power supply and hence we are using them more as stand-by power plants
Clean energy is the mantra of the NDA government. The emphasis is on solar and wind energy. It is estimated that about 100 GW of solar capacity will be established in the country by 2030.If sustainable domestic manufacturing industry is promoted, it can save $42 billion in equipment imports as India continues to be deficient in solar power equipment manufacturing.

4.9.7 FORCAST :-

Globally demand for electricity is expected to grow more than the demand for any other form of energy averaging 3 % for the next two decades as per projections in the World Energy Outlook 2016 (WEO 2016). Among large economies, electricity demand in India is expected to grow at the fastest rate of 4.4% which is lower than that of assumptions in domestic projections. According to WEO 2013, India is likely to add an additional 488 GW capacity to its existing capacity by 2035. To the delight of climate change and renewable energy activists 38% (or 186 GW) of this would be derived from non-hydro renewable energy forms such as wind and solar energy. To put this figure in perspective, India is likely to add as much renewable energy capacity as it did overall power generating capacity 60 years. Though low plant load factors will limit actual generation from renewable sources this is a phenomenal increase in renewable energy capacity. Only 31% (or154 GW) of power generating capacity to be added by 2035 would be based on coal, 16% (or 80 GW) from gas, 9% (42 GW) from hydro, 4% (about 21 GW) from nuclear and the rest from oil and other sources. According to WEO 2035, cumulative power generating capacity in India as of 2035, is expected to touch 717 GW. Out of this 40% (288 GW) would be coal based, 15% (106 GW) wind based 14% (100 GW) gas based, 13% (92 GW) solar based, 11% hydro (82) based 4% (26 GW) nuclear based and the rest based on bio fuels and oil. What comes out clearly from these figures is that India's fuel mix for power supply is likely to undergo dramatic change and take a turn towards a low carbon path in the next two decades. Roughly half of the coal based capacity to be added is likely to be based on supercritical technologies. This will raise average efficiency of India's Indian coal-fired generation which is quite low compared to global bench-marks at the moment. WEO anticipates coal-fired generation to increase in efficiency by 8% and improve efficiency from 28% to 36% by 2035. A 1% increase in efficiency (heat rate) in coal fired generation is likely to decrease carbon emissions by 1-2%. In addition the dramatic increase in renewable power generation capacity will firmly put India in the low carbon club. Tentative State wise breakup of Renewable power generation target achived in 2020 (Table 23). The global captive power generation MARKET is projected to rise at moderate rate in the future. MARKET's growth is primarily driven by the increasing global power demand along with the rising cost of electricity. The presence of cross-subsidy element in the power tariff increases per unit cost of power generation; it is likely to increase demand for captive power generation around the world. The need for quality and reliable power along with reduced wastes and fuel flexibility is also likely to drive growth in the captive power generation MARKET. Poor reliability and quality along with non-availability of power have forced heavy industries to set up their own captive power generation plants rather than to rely on the power supply from the electricity grid. Increasing investment in renewable energy sources for power generation is likely to drive growth in the renewable captive power generation market. Symbiotic relation of power generation technologies to the MANUFACTURING process is likely to augment growth in the global captive power generation market.The global captive power generation market is steadily increasing and is projected to grow at a moderate rate in the future. Asia Pacific accounts for the highest market SHARE in the global captive power generation market; it is also expected to grow at the highest rate in the future. India contributes the most to the growth of Asia Pacific's captive power generation market; poor quality, reliability and non-availability are likely to drive the market's growth in the region. Equipment Equipment and EPC services market would be in better position with the expected creation of over 300 GW of electricity generation capacity by 2022. The opportunities comes in the area of supply of key components such as heavy castings and forgings, special steel pipes, balance of plant and engineering, procurement and construction services.

The report deeply identifies power generation need for major industries with existing upcoming plants, capacity additions. It also provides industry wise cost benefit analysis between costly grid power vs. setting up CPPs. Valuable inputs, suggestions, observations have been rendered by industry professionals to make the report stand out of the class.

Besides the analysis part, the report identifies a list of over 700 existing and upcoming CPPs which opens significant business opportunities

TABLE 23:

Tentative State-wise break-up of Renewable Power target to be achieved by the year 2022
So that cumulative achievement is 1,75,000 MW

State/UTs	Solar Power (MW)	Wind (MW)	SHP (MW)	Biomass Power (MW)
Delhi	2762			
Haryana	4142		25	209
Himachal Pradesh	776		1500	
Jammu & Kashmir	1155		150	
Punjab	4772		50	244
Rajasthan	5762	8600		
Uttar Pradesh	10697		25	3499
Uttrakhand	900		700	197
Chandigarh	153			
Northern Region	31120	8600	2450	4149
Goa	358			
Gujarat	8020	8800	25	288
Chhattisgarh	1783		25	
Madhya Pradesh	5675	6200	25	118
Maharashtra	11926	7600	50	2469
D. & N. Haveli	449			
Daman & Diu	199			
Western Region	28410	22600	125	2875
Andhra Pradesh	9834	8100		543
Telangana		2000		
Karnataka	5697	6200	1500	1420
Kerala	1870		100	
Tamil Nadu	8884	11900	75	649
Puducherry	246			
Southern Region	26531	28200	1675	2612
Bihar	2493		25	244
Jharkhand	1995		10	
Orissa	2377			
West Bengal	5336		50	
Sikkim	36		50	
Eastern Region	12237		135	244
Assam	663		25	
Manipur	105			
Meghalaya	161		50	
Nagaland	61		15	
Tripura	105			
Arunachal Pradesh	39		500	
Mizoram	72		25	
North Eastern Region	1205		615	
Andaman & Nicobar Islands	27			
Lakshadweep	4			
Other (New States)		600		120
All India	99533	60000	5000	10000

The future of captive generation is very bright as industrial demand will keep on increasing and activities like trading through exchange will provide a platform to captive generators to sell surplus power at a profitable margin.

4.10: POWER SCENARIO IN UTTAR PRADESH

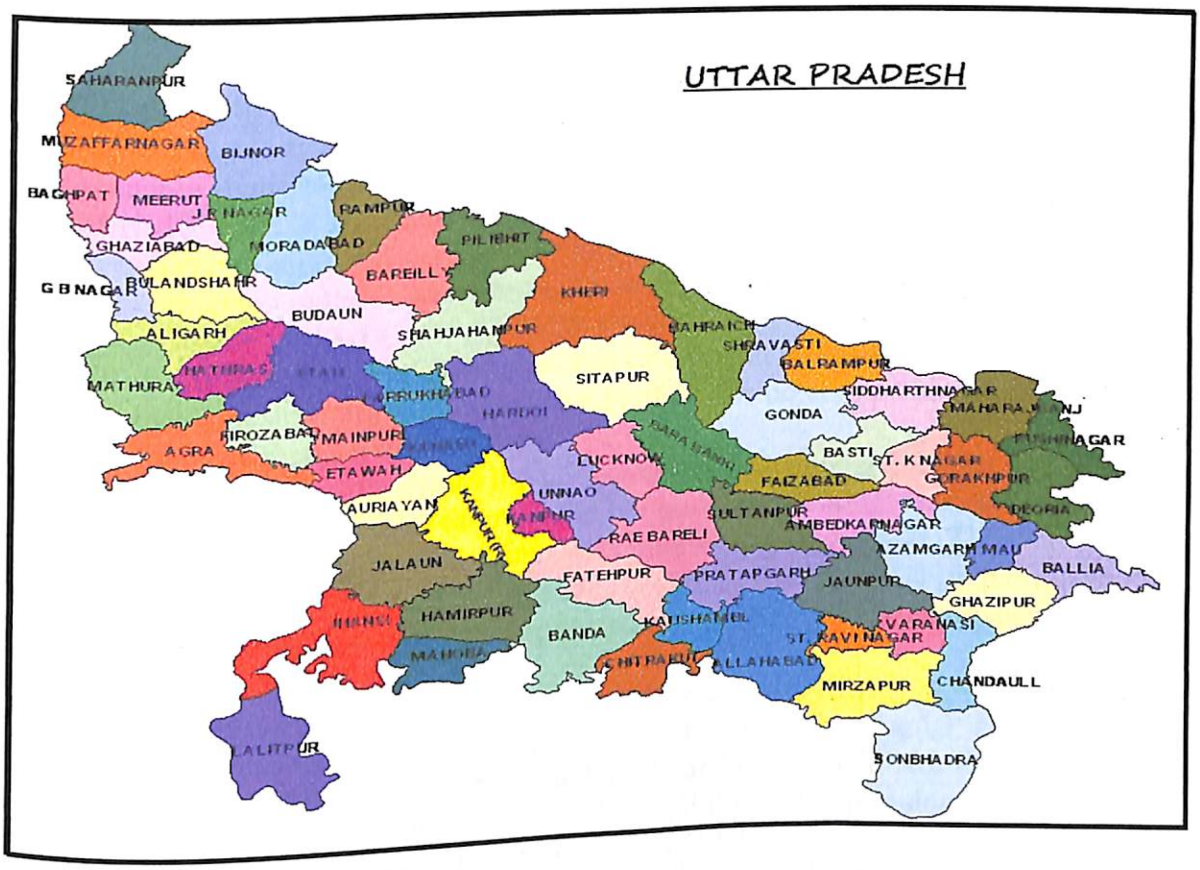


Fig 30 : State Uttar Pradesh Map

Fig 31 : India map showing State Uttar Pradesh.

4.10.1 OVERVIEW

STATUS OF THE POWER SECTOR

Uttar Pradesh regularly experiences power crises because demand for electricity frequently exceeds supply significantly. Over the last 20 years power shortage has remained within the range of 10-15%, while shortages in periods of peak demand reaches at even higher levels. In 2013, even a gap of up to 43% opens up between the state's demand and supply of electricity. As per figures presented in the Power Ministry's review meeting in March, the state's projected demand for summer 2013-14 is 15,839 MW showing a gap of 6,832 MW. This results in poor and unreliable power supply with rampant power cuts and prolonged periods of low voltage. As a consequence industrial investment in Uttar Pradesh has been constrained, with industries preferring to locate themselves elsewhere

This situation also repeatedly forces the UP government to purchase power for high prices from other states in India. In 2011 for example the UP government bought power at rates as high as Rs 17 per unit from the central pool to ensure adequate supply in the state. This practice regularly incurs significant financial losses to the State Electricity Board, which (in part) have to be borne by the UP state government, constraining the state's expenditures in areas social development such as education and public health.

In 1999 the UP government tried to address the problems of growing power shortage and poor financial condition of the State Electricity Board (SEB) by reforming UP's power sector. The power sector was restructured in order to unbundle and privatize it. Accordingly the SEB has been divided into three independent cooperation: UP Power Corporation Limited (UPPCL), UP Rajya Vidyut Utapadan Nigam (UPRVUNL) and UP Jal Vidyut Nigam (UPJVNL) – responsible for transmission and distribution, thermal generation, and hydro generation, respectively. Another distribution company, Kanpur Electricity Supply Company (KESCO) was formed as a 100% subsidiary of UPPCL.

However, the UP Electricity Reform Act, formulated in 1999, had several shortcomings, which is a major reason for the problems of the UP power sector to persist until today. Besides not curtailing the enormous powers of the Uttar Pradesh Energy Regulatory Commission by making it accountable, and besides omitting the promotion of efficiency and energy conservation, the act did not address the main reasons for the financial problems of the SEB: High cost of power purchase in relation to the lower tariffs for consumers, which are determined by the UP government (no tariff adjustment), and arbitrary depreciation methods Additionally, the unbundling of the power sector was limited and did not lead to competition.

- **Power supply:**

U.P. Power Corporation Ltd. was at to meet both in energy and demand through out the state with Minimum possible restrictions and control measures.

- **Maximum Demand &: Energy Consumption:**

During the year 2013-14 maximum demand met was 12327 MW on 30.11.2013 at bus bar against maximum demand recorded 15044 MW on 06.09.2013 and highest dally energy supply was 268.5 MU on 29.05.2013 against maximum demand of 305.6 MU on 25.05.2013.

- **Transmission&: Distribution Infrastructure:**

Total existing 765KV, 400 KV, 220 KV 132 KV sub-stations, distribution secondary sub stations and lines as on 31.03.2014 in Table :24 and Table 25

Table 24

Sl. No.	Details	As on 31.03.2014
A	765 KV	
1	No. of 765 KV sub-station	1
2	Total Capacity (MVA)	2000
3	Total 765 KV Line (Ckt. Km.)	410.93
B	400 KV	
1	No. of 400 KV sub-station	14
2	Total Capacity (MVA)	9195
3	Total 400 KV Lines (Ckt. Km)	4777.73
C	220 KV	
1	No. of 220 KV sub -stations	75
2	Total Capacity (MVA)	23570
3	Total 220 KV Lines (Ckt. Km)	8175.20
D	132 KV	
1	No. of 132 KV sub-stations	287
2	Total Capacity (MVA)	28803
3	Total 132 KV Lines (Ckt. Km)	14263.67

Table 25

Sl. No.	Details	Lines (Ckt. Km.)	Nos.	MVA
1	66 KV lines & sub-stations as on 31.03.2013 and their capacity in MVA	3139	26	344.50
2	37.5, 33 KV lines and sub-stations as on 31.03.2013 and their capacity in MVA	35344.4	2889	28322.5
	Total capacitor banks existing on 31.03.2013 in MVAR			6417.4

- **Rural Electrification:**

Out of 97942 villages as per 2001 Census the electrification of 89140 villages, 99173 Scheduled Caste basties up to 31.03.2014 have been carried out. The electrification of remaining villages is continued. The total no. of consumers in the state and their connected load as on 31.03.2014 is 14264942 nos. and 38812 MW.

- **Financial Achievements:**

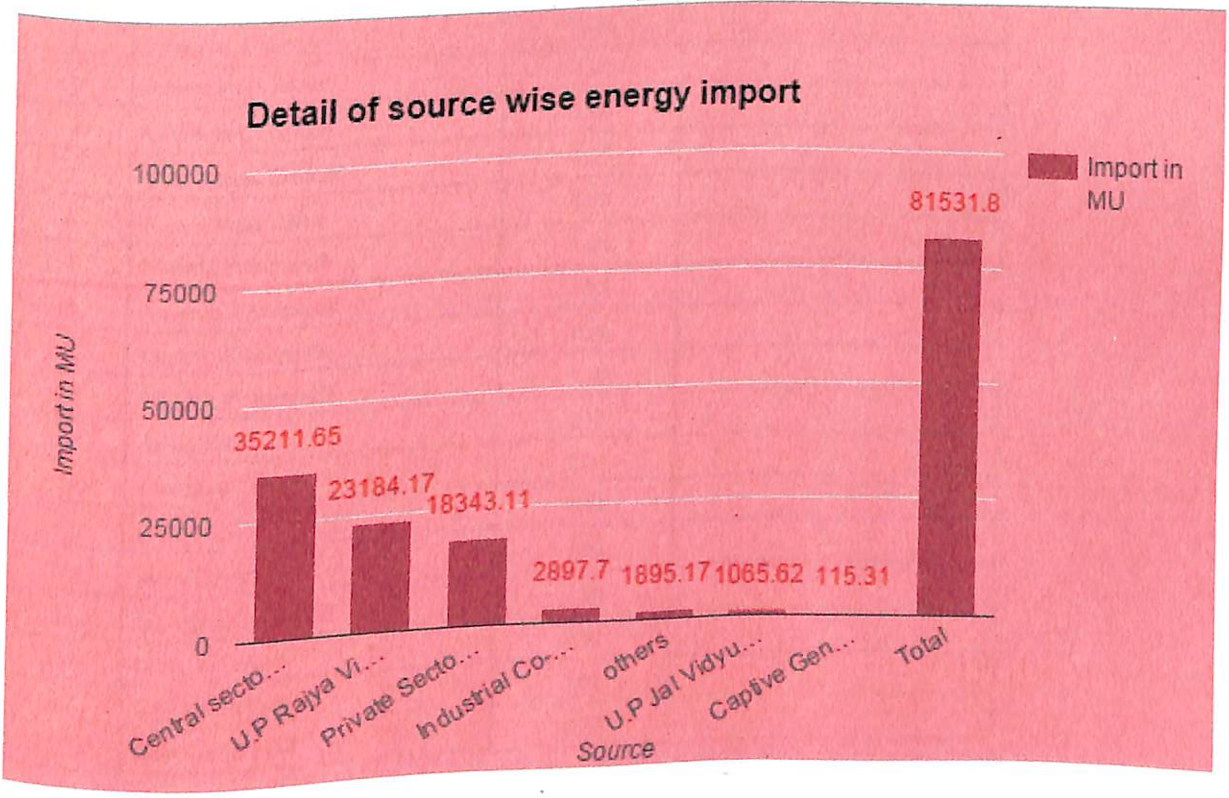
The revenue receipts during 2012-13 is Rs. 17912.71 crores and Rs. 27975.38 crores for the year 2013-14 so there is 56.2% increase in the revenue as compared to previous year.

Details of source wise energy Import Is as follows during the year 20013-14 (Table 26 , Fig 32)

Table 26:

SL No.	Name of Source	Import in MU
1	U.P. Rajya Vidyut Utpadan Nigam Ltd.	23184.17
2	U.P. Jal Vidyut Nigam Ltd.	1065.62
3	Central Sector Projects	35211.65
4	Private Sector (IPP)	18343.11
5	Industrial Co-generation	2897.70
6	Captive Generation (Hindalco, Kanoria) etc.	115.31
7	Others (WR, UI, OA)	1895.17
	Total	82712.73

Fig 32



UPPCL distribution network gets major portion of thermal and hydro power from UPRVUN and

UPJVN respectively along with the central sector generation plants and a small portion from private sector power generation /cogeneration plants and ultimately distributed to the consumer / end users. Source wise present installed capacity and power generation in UP shows that the share of UPPCL coal based power projects is 73 % of total UPPCL installed capacity and 77% of total generation capacity in the state. Detailed break-up is as under(Table 27 & 28).

TABLE 27 : LIST OF CPP RENEWABLE ENERGY PROJECTS AVAILABLE IN THE STATE OF UTTAR PRADESH

Sr.No.	Name of Project & Location	Capacity (MW)	Remarks
A.	**Small Hydro**		
A1.	New Small & Micro hydel projects to be implemented	117 (estimated)	44 projects are under detailed survey. UPPCL already signed MoU's with 23 projects of total capacity 68.50 MW
A2.	**Partial list of the projects is as under**		
1.	Harsila, Almora	1.00	These projects are open for private sector participation
2.	Mansuna, Chamoli	2.00	
3.	Palalganga, Chamoli	1.40	
4.	Gaurikund, Chamoli	2.00	
5.	Gharitganga, Chamoli	1.25	
6.	Baram, Pithoragarh	1.00	
7.	Bhadeli, Pithoragarh	1.00	
8.	Jimigarh, Pithoragarh	1.35	
9.	Chalthi, Pithoragarh	1.50	
10.	Seragad, Pithoragarh	1.50	
11.	Aglar, Tehri	1.35	
12.	Lastergad, Tehri	1.20	
13.	Jalkur, Tehri	2.00	
14.	Jakhol, Uttarkashi	2.00	
15.	Sawrigad, Uttarkashi	1.50	
16.	Siyan, Uttarkashi	3.00	
17.	Supin, Uttarkashi	3.00	
	SUB TOTAL A2	28.05	

Sr.No.	Name of Project & Location	Capacity (MW)	Remarks
A3.	Additional estimated Potential	600	Expected to be implemented by 10th & 11th FYP
	Sub Total A	717	
B.	Municipal Solid Waste		
1.	Agra	8.00	These projects are open for private sector participation (Expected to be implemented in 2-3 years)
2.	Aligarh	5.00	
3.	Allahbad	7.00	
4.	Bareilly	7.00	
5.	Ghaziabad	5.00	
6.	Gorakhpur	5.00	
7.	Kanpur	20.00	
8.	Lucknow	20.00	
9.	Meerut	7.00	
10.	Muradabad	5.00	
11	Varanashi	8.00	
	Sub Total B	97.00	
C.	Bagasse Cogeneration		
C1.	Actual implementation	40	Implemented by 7 sugar mills.
C2.	Additional Projected potential	700	It is expected that around 300 MW will be implemented by 10th FYP.
	Sub Total C	740	
	Total	1554	

TABLE 28 UTTAR PARADESH ALLOCATED POWER CAPACITY AS OF JULY 2015

Thermal (in MW)				Nuclear	Renewable (in MW)			Total	% of Total
State	Coal	Gas	Diesel	(in MW)	Hydel	Other Renewable	Sub-Total Renewable	(in MW)	
Uttar Pradesh	11,677.95	549.97	-	335.72	2,168.30	989.86	3,158.16	15,721.80	5.70%

4.10.2 DISCOMS IN UPPVNL

- **POORVANCHAL**

Purvanchal Vidyut Vitaran Nigam Limited aims to promote a new interface between the Nigam and its valued consumers. It is our firm belief that value addition to the site content with passage of time will bring both of us closer still. They have added the RTI through which our valued consumers get benifited. Publication of Tenders over the web is yet another example of our continued efforts to make best use of the World-Wide-Web technology.

- **MADHYANCHAL**

Madhyanchal Vidyut Vitran Nigam Ltd. is a company incorporated under the Companies Act, 1956 and having its registered office at 4-A, Gokhle Marg, Lucknow, for carrying out the business of Distribution of electricity within the Area of Supply. Area of supply will include districts of the State of Uttar Pradesh: Budaun, Bareilly, Pilibhit, Shahjahanpur, Lakhimpur, Hardoi, Sitapur, Unnao, Bahraich, Shrawasti, Balrampur, Gonda, Barabanki, Rae Bareli, Faizabad, Sultanpur, Ambedkarnagar, Lucknow and Chhatrapati Sahuji Maharaj Nagar

- **PASCHIMANCAL**

From July 2003 onwards Paschimanchal Vidyut Vitaran Nigam Limited has inherited the responsibility for distribution of power in western Uttar Pradesh from UPPCL. PVVNL is committed to rapid improvements in efficiency of power distribution to achieve 24-hour availability of quality power for all consumers.

- **DAKSHINANCHAL**

Dakshinanchal Vidyut Vitran Nigam Ltd. is responsible for power distribution in the 21 districts of Uttar Pradesh. DVVNL covers an area of 31,34.95 Sq. Kms. with 4,38,42,782 population.
The Discom covers in its jurisdiction the areas of District Agra, Mathura, Mainpuri, Aligarh, Hathras, Etawah, Etah, Farrukhabad, Firozabad, Kanpur City, Kanpur rural, Banda, Jhansi, Kannauj, Auraiya, Jalaun Urai, Hamirpur, Mahoba, Lalitpur, Chitrakoot, Kanshiram Nagar

- **KESCo**

Kanpur Electricity Supply Company Ltd. is a company incorporated under Companies Act, 1956 and having its registered office at 14/71, Civil Lines, Kanpur-208001. Kanpur Electricity Supply Company Ltd. was formed on 14 January 2000 under U.P.

Electricity reform act 1999. This company is registered for distribution of electricity in the area under Kanpur City (Urban) by U.P. Government Gazette No. 118/P.-1/2000/24-152-P./98 published on 13/01/2000. According to geographic condition the complete region of Kanpur Nagar Nigam is decided as the work area of KESCo. Boundaries of above KESCo region are upto river Ganga in North, upto river Pandu in South, upto I.I.T. campus in West and up to villages of Chakari in East. The total area supplied electricity by KESCo is around 500 Square K.M., which comes in jurisdiction of Kanpur Nagar Nigam. Kanpur is the main hub of industries in North India. The big industries in the KESCo region are M/s Lohia Machines Ltd., M/s H.A.L., Ordinance Factory, Small Arms Factory, Field Gun Factory, Tanneries and Ganga pollution institute etc. KESCo is serving around 700 bulk consumers and 4,35,000 other consumers of domestic, commercial and power categories connected to grid through 66 no. 33 KV substations and 340 no. 11 KV feeders after receiving electricity from 7 transmission substation of 220 KV and 132 KV of U.P. Power Transmission Corporation Ltd. KESCo has installed total 146 power transformers (capacity 935 MVA) and 3215 distribution transformers in its distribution network.

4.10.3 CONSTRAINTS AND OPPORTUNITIES

The majority of power generated in Uttar Pradesh is reliant on coal, while the limited availability and high prices of coal have aggravated the precarious power situation in UP. Hence, there is an obvious need to develop alternate sources of energy. Uttar Pradesh is rich in renewable energy recourses such as biomass, solar and bio-fuels, of which only biomass has been considerably exploited. Uttar Pradesh is blessed with a good solar irradiation to the tune of 1,800 KW/h per m^2 on an annual average basis, which is considered necessary for operating a solar photovoltaic power plant. Thus, there are immense possibilities in this sector. Growth of renewable energy would definitely help the state in meeting its energy requirements

4.10.4 POLICY, FRAMEWORK, LAWS & REGULATIONS

In January, the Uttar Pradesh Cabinet approved the first-ever solar energy policy of the state. Under this policy, a target of producing 1000 MW of electricity through solar energy has been set by March 2017. For the purpose of promoting production of electricity by solar energy, a U.P. renewable energy fund has been created

4.10.5 CAPTIVE POWER GENERATION REGULATION BY UTTAR PRADESH ELECTRICITY REGULATORY COMMISSION

1. OBJECT:

As per the provisions of the Act, supply of electricity from a Captive Generating Plant through the grid shall be regulated in the same manner as the Generating Station of a Generating Company. These Regulations seek to achieve efficient,safe, well-coordinated operation of the plant, connectivity with the grid and exchange of information among the various utilities in the

State grid, Central Utilities and Northern Regional Grid, as the case may be. Non-compliance of these Regulations shall be liable for action under the appropriate provision of the Act.

2. GENERATION FROM CAPTIVE POWER PLANTS

- A power plant shall qualify as a 'Captive Generating Plant', under Section 9 read with Section 2(8) of the Act and Rule 3 of The Electricity Rules,2005.
- It shall be the obligation of the Captive Users to ensure the captive consumption at the percentages mentioned in The Electricity Rules, 2005.In case the minimum percentage of captive use is not complied with in any year, the entire electricity generated shall be treated as if it is a supply of electricity by a Generating Company.

3.GENERAL CONDITIONS FOR CAPTIVE GENERATING PLANTS

- These Regulations shall apply to all existing Captive Generating Plants as well as proposed Captive Generating Plants having an installed capacity of 1 MW or above irrespective of their connectivity with the grid. Any person intending to set-up a Captive Generating Plant shall submit the detailed project report, scheduled date of commercial operation and half yearly progress report of construction of the plant to the Commission for information and record. The necessary information to be accompanied with the detailed project report of these Regulations:
- Provided that all existing Captive Generating Plants (whether connected with the grid or not) shall furnish the desired information of these Regulations within 90 days from the date of notification of these Regulations. Non-compliance shall be liable for action under the appropriate provisions of the Act.
- The provisions of ABT in respect to functions, duties and obligations, as provided, for Generating Plants under ABT shall apply to Captive Generating Plants.
- The Captive Generating Plant shall abide by the grid discipline and shall not be entitled to any compensation in the event of grid failure or any interruptions or damage to the plant or its associated sub-stations or transmission line on account of any happening in the grid.
- All provisions of these Regulations except for those relating to supply in the grid and tariff shall also apply to the captive plants having no connectivity with the grid.
- The Commission may in its discretion refer any technical matter relating to Generation and Transmission to Central Electricity Authority for examination.

4. OBLIGATIONS OF THE CAPTIVE GENERATING PLANT

- The Captive Generating Plant shall establish, operate and maintain Generating Station, substation, tie lines and dedicated transmission lines connected thereto in accordance with:

a. The technical standards for construction of electrical plants, electric lines and connectivity with the grid as specified by the Authority;

b. Safety requirements for construction, operation and maintenance of electrical plants and electric lines as specified by the Authority;

c. Uttar Pradesh electricity Grid Code (UPEGC) or Indian Electricity Grid Code (IEGC);

d. The conditions for installation of meters for supply of electricity as specified by the Authority and / or the State Transmission Utility (STU).

- In extraordinary circumstances, the Captive Generating Plants shall operate and maintain the plant in accordance with the directions issued by the State Government and the Commission may offset the consequential adverse financial impact of such direction, as it considers appropriate.

5 . DUTIES OF THE CAPTIVE GENERATING PLANT

- . The Captive Generating Plant shall generate electricity primarily for its own use and shall:

a. Submit the technical details regarding its Generating Stations to the Appropriate Commission and the Authority;

b. Submit information to the Commission in respect to availability,generation achieved, demand met, plant load factor, auxiliary consumption, specific heat rate, specific oil consumption and other information of these Regulations;

c. Co-ordinate with SLDC and / or STU for scheduling and dispatch of electricity.

- . The plant shall be under obligation to comply with the directions issued to it by SLDC and shall pay fee and charges payable to SLDC as specified by the Commission from time to time.
- . The Captive Generating Plant shall not be required to obtain license under the Act for establishing, operating or maintaining a dedicated transmission line.
- The Captive Generating Plant shall ensure compliance of all general or specific direction, Rules or Regulations made by the Commission for the generating companies.
- . The Captive Generating Plant shall ensure that the Distribution Licensee has submitted Power Purchase Agreement to the Commission as mentioned in Regulation 17(1) of these Regulations for approval.

6 . OPEN ACCESS

- A Captive Generating Plant shall have right to 'open access' for carrying electricity from its plant to the destination of its use by using transmission and/or distribution system or associated facilities with such lines or system and for that purpose, Rules, Regulations and Orders passed by the Appropriate Commission shall apply.

- The plant seeking 'Open Access' within or outside the State through the grid shall be regulated under Regulations specified by the Appropriate Commissions.

7. TRANSMISSION CHARGES AND WHEELING CHARGES

The Plant or the Consumer, seeking 'Open Access' to the State and / or Inter State Transmission Systems and / or distribution system for carrying the electricity to the destination of use, shall pay the transmission charges, wheeling charges and such other charges for use of such facilities as determined by the Appropriate Commission(s).

8. SURCHARGE AND ADDITIONAL SURCHARGE:

- A Captive Power plant shall not be liable to pay surcharge over and above transmission and / or wheeling charges for carrying the generated electricity from its plant to the destination of its own use or for the use of its members, as prescribed under the Act: Provided that in case of supply of power to a consumer or to a person other than its members, such consumer or person shall pay surcharge over and above transmission and wheeling charges as determined by the Commission.
- Open Access Consumer receiving supply of electricity from a person other than the Distribution Licensee of his area of supply, shall pay an additional surcharge, over and above transmission and / or wheeling charges and surcharge, as determined by the Commission.

9. SALE OF POWER

- A Captive Generating Plant may enter into an agreement with the Distribution Licensee for sale of its surplus capacity based on Model PPA available to these Regulations. The parties to the agreement may make plant / site specific changes in the Model PPA not inconsistent with the Act and relevant Regulations. Such changes shall however be subject to approval of the Commission: Provided that the plant may also supply electricity to a consumer who is permitted open access as per provisions of Open Access Regulations.
- The Distribution Licensee shall pay the transmission charges and / or wheeling charges for such supply, as may be determined by the Commission: Provided further that Distribution Licensee may require emergency assistance following an extensive failure in the system. Subject to technical feasibility, the Captive Generating Plant may, if requested by the Licensee, extend power supply from its Generating Station to the Licensee's system. In such circumstances, the tariff for such supply shall be mutually agreed.

10. TARIFF

The tariff for supply of electricity by a plant at pithead location to a Distribution Licensee shall be as per Schedule I of these Regulations:
Provided that the Commission shall approve the transportation cost of fuel for non-pithead locations on case to case basis on a petition filed by the Generating Plant.

Note:

- The tariff for supply of electricity from the plant, having more than one unit commissioned in different years, shall be based on weighted average of the contracted capacities of the units commissioned in different years.
- The tariff for supply of electricity during the period of synchronization and commissioning of the unit shall be equal to the variable cost.

11. PURCHASE OF ELECTRICITY

Any person, who establishes, maintains and operates a Generating Plant, may purchase electricity from a Generating Company or Distribution Licensee in case his plant is not in a position to generate electricity to meet the requirement in the event of emergency or shut down or maintenance of the plant including supply to township housing the operating staff:

Provided that such purchase of electricity, from a Distribution Licensee of the area in which the plant is located, shall be charged under appropriate category of the rate schedule of tariff. This shall apply only to those generators who have entered into PPA with the Distribution Licensee:

Provided also that in case of purchase of power for purposes other than mentioned above, the generator may purchase electricity through a trader or a Generating Company or a Distribution Licensee other than Distribution Licensee of the area in which the plant is located at the rate as mutually agreed however, surcharge and additional surcharge besides other charges shall be payable as determined by the Commission:

Provided further that the tariff payable by a captive plant to a Distribution Licensee, in case of banking of energy, shall be as per Regulation 40(2) if that plant has an arrangement of banking of energy with such Distribution Licensee.

12. CAPACITY OF THE PLANT & LOCATION

- The capacity of the plant shall be based on the need of a person intending to establish a Captive Generating Plant. The location, fuel linkage and other required resources may be in conformity with the National Electricity Policy and National Electricity Plan.
- Captive Generating Plant owner shall clearly mention the fuel linkages in the project report and ensure that Government of India/State Government guidelines regarding use of fuel are complied with.

13. ENVIRONMENTAL CLEARANCE

The Captive Generating Plant owner shall abide by the emission standards set by the Union/State Government. The Captive Generating Plant shall obtain all the required environmental and pollution clearances from the Central / State pollution control authorities and submit copies of Clearance Certificates to the Commission.

TABLE 29

DETAILS OF APPLICANTS OF CAPTIVE POWER PLANTS WHO HAVE SOUGHT LONG-TERM COAL LINKAGE

DEFERRED PROPOSAL CAPTIVE POWER PLANTS

S. No.	Name & Location of Unit	Quantity requested by applicant.	Capacity MW	Source Wanted
1.	M/s. Adhunik Ispat Pvt. Ltd,Bankura, WB (2x25 MW =50 MW)	2.82	50	ECL/CCL
2.	M/s. Jai Balaji Sponge ltd. G-1 Mangalpur Industrial Complex. Raniganj, Distt. Burdwan, WB	3.95	72	ECL/CCL/ MCL
3.	M/s. Shri Ramrupai Balaji Steels Ltd. At Durgapur, WB	5.89	120	ECL/CCL/MCL
4.	Ma Chandi Durga Ispat (P) Ltd. Mozra Block, Distt- Jamtara, Jharkhand	6.14	125	ECL/CCL
5.	Jagdamba Fiscal Services Pvt Ltd Nala Block, Bindhapathar, dist-Jamtara, Jharkhand	6.14	125	ECL/CCL
6.	M/s. Durgapur Metaliks Ltd At block-Nala, Binda Pathar, dist-Jamtara, Jharkhand	6.14	125	ECL/CCL
7.	M/s. Adhunik Alloys & Power Ltd ASt Vill- kandra distt- Saraikela, kharsawan, Jharkhand	1.76	30	CCL/MCL
8.	Gupta Metallics & Power Ltd Vill. Chunala, Tah. Rajura, Dist. Chandrapur, Maharashtra	2.25	40	WCL
9.	Maharashtra Airport Development Authority Ltd(MADC) Special Economic Zone area at Nagpur, Maharashtra	-	2x50	WCL/SECL
10.	M/s. Vandana Global ltd Siltara Industrial Area Raipur, CG	5.49	100	SECL
11.	M/s. Hindustan Zink Ltd. Chanderia, Chhittorgarh, Rajashthan	7.56	154	SECL
12.	AMR Iron and Steel Private Limited 178-C,Light Industrial Area, Bhilai-490026 (23 MW CPP	12.04	250	SECL
13.	Jagdamba Power & Alloys Ltd Vill. Murethi, Tehsi & District. Rajpur State CG. 492001	12.04*	25	SECL
14.	M/s. Sagar Energy and Steels ltd. Bilaspur, Chhattisgarh	1.46	25	SECL
15.	M/s. Chhattisgarh Steel & Power Ltd Village Amjher Distt. Janjgir Champa CG	5.53	112.5	SECL
16.	Maheshwary ispat Limited At village Rampei, Cuttack distt, Orissa	5.40	110	SECL/MCL
17.	Indo Sponge Power Private Limited Plot No. 237, Kosabadi, PO Korba,	1.76	30	SECL

SOME NEWS :-

Uttar Pradesh government plans 24-hour power supply after 2019

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By PTI | 26 Aug, 2015, 03.22PM IST

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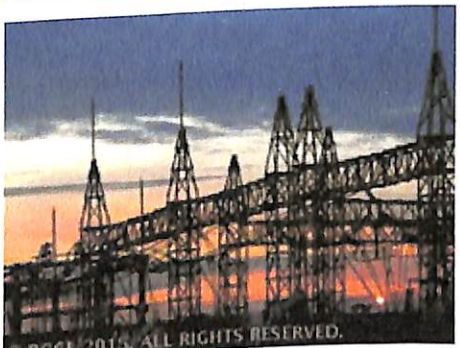

The Uttar Pradesh government today said it has proposed round-the-clock power supply, except for tubewells, at all places in the state after 2019.

LUCKNOW: The Uttar Pradesh government today said it has proposed round-the-clock power supply, except for tubewells, at all places in the state after 2019.

"After 2019, 24-hour power supply is proposed at all places except for tubewells," state power minister Yasir Shah said in a reply during Question Hour in the Assembly today.

"As per the vision-2016, it has been decided to ensure 24 hour power supply in big cities, 22 hour in district headquarters, 16 hour in tehsil and rural areas from October 2016," Shah said in while replying to a query of BJP member Satish Mahana.

On the present power scenario, the minister said 24 hours power is being supplied to Taj Trapezium Zone (Agra) and industrial areas while 20 hours to big cities and 18 hours at divisional level.

The district headquarters and Bundelkhand region were supplied 15 hours of power while the same stood at 12 and 10 hours in tehsil and rural areas respectively, he added.

CM Akhilesh Yadav assures better solar energy sector in Uttar Pradesh

By PTI | 21 Aug, 2015, 03.07PM IST

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LUCKNOW: Emphasizing on having a better solar power generation in the state, Uttar Pradesh Chief Minister Akhilesh Yadav today said despite all budgetary limitations the government was making all efforts to promote this sector.

Uttar Pradesh Chief Minister Akhilesh Yadav today said despite all budgetary limitations the government was making all efforts to promote this sector.

"Some states in the country are progressing with a fast pace in solar energy sector. Uttar Pradesh too wants to progress, but it has budgetary limitations. In the coming time we will try to fast forward the pace for which a number of decisions have been taken," Akhilesh said while addressing a programme organised by UPNEDA.

Yadav said that if Germany was leading and the US was doing a very good work, then India should follow the league and UP should not lag behind.

He said that in terms of population and market, UP was a front runner.

The Chief Minister said that a lot has been done in solar power generation in the state including solar policy maximum investment done in Bundelkhand region.

He said that the state provided land to the Centre wherever it was required to set up a solar power plant.

Referring to high cost of solar power generation, he said that both cost and profit has to be looked into. At present only two villages have been associated with 24-hour solar power facility and if budget allowed then more villages would be included in the programme.

People have become aware towards use of solar energy as solar panels were visible on many buildings, he added.

"It takes a lot of time to set up a big unit. There are number of units which have not been energized and even if made functional it not sure for how long they will run. In solar energy there is one surity that we will get power with sunrise," he said.

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Business Standard

BJP demands 'white paper' on power scenario in Uttar Pradesh

IANS | Lucknow
May 15, 2015 Last Updated at 16:44 IST

1

The Bharatiya Janata Party (BJP) on Friday demanded a white paper by the state government on the power scenario in the state.

Party spokesman Chandra Mohan, accusing the Samajwadi Party (SP) government in the state of "presiding over a mess in the power sector", said only a white paper can expose the lacunae in the power sector.

Talking to reporters at the state party headquarters here, the BJP spokesman said the endless power outages across the state within the first month of summer have exposed the tall and false claims of the Akhilesh Yadav government that the power situation was much better than the previous years.

"...it is shocking that the chief minister is blatantly lying about the power situation and is trying to hoodwink the people," the BJP leader said citing how the new Anpara D unit was inaugurated with much fanfare recently but not a single unit of electricity has been produced there so far.

Because of poor maintenance and overloading, many transformers in the state have crashed, he alleged and added that wherever new transformers had been installed by the state government they were of poor quality and were not able to bear the overloading in peak summer.

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Bedi promises people a 'Good Delhi' before filing her nomination

CONCLUSION:-

Energy is vital for development and this means that if India is to move to a higher growth trajectory than is now feasible, it must ensure the reliable availability of energy. The present energy scenario in Uttar Pradesh is not satisfactory. The power supply position prevailing in the U.P. is characterized by persistent shortages and unreliability and also high prices for industrial consumers. There is also concern about the position regarding petroleum products. India depends to the extent of 70-80 percent on imported oil, and this naturally raises issues about energy security. These concerns have been exacerbated by recent movements in international oil prices. Electricity is produced domestically but its supply depends upon the availability of coal, exploitation of hydro power sources and the scope for expanding nuclear power, and there are constraints affecting each source. A vibrant functioning society needs energy as its lifeline and the quantum of its use indicates the quality of life being experienced by its members. There is a great disparity in the energy use amongst different regions of the world and even for countries like India where the rural areas are bereft of the benefits of energy and where obtaining food and shelter is a daily challenge. U.P needs to bridge this divide as soon as possible and this is of paramount importance for any growth which should include all sections of society.
Energy is central to achieving the interrelated economic, social, and environmental aims of sustainable human development. But if U.P is to realize this important goal, the kinds of energy they produces and the ways it uses them will have to change. Otherwise, environmental damage will accelerate, inequity will increase, and economic growth will be jeopardized. All energy sources are having advantages as well as certain disadvantages but resources are not an end in themselves, and their attractiveness must be seen in the context of societies' energy service needs,of the technologies that convert resources into energy services ,and of the economics associated with their use. These analyses have shown that U.P will have to plan for the fulfillment of its energy needs based on a judicious mix of the natural resources endowed to it, keeping sustainable development in focus and having a minimum carbon foot print. Developed countries of the world also need to understand that climate change is a phenomenon which has no boundaries and the world is facing this threat because of skewed policies followed by them and they are also duty bound to help India attain the goal of achieving energy security for its population by the transfer of clean [energy] technology and by making available appropriate funding mechanisms. In Uttar Pradesh its vast population and limited natural resources for meeting its energy requirements, needs to maintain its momentum of growth and this can be made possible only with a clear strategy for use of best possible energy options available. U.P. needs to have a long term strategy for meeting its energy needs by 2050 and a short term goal of 2020 which can be small steps towards attaining energy security by 2050. The broad vision behind energy policy must be to meet energy demands reliably with energy which is clean and

affordable and this must be done in an environmentally sustainable manner using different fuels and forms of energy, conventional and non-conventional, as well as new and emerging sources to ensure supplies at all times.. Further, U.P needs to fully exploit the potential of other renewable energy sources like bio fuels, wind, hydro and even nuclear energy, as projections of energy requirements indicate an approximately three times increase from around 620 Mtoe in 2008 to 2043 Mtoe by 2031-32. It means that U.P. needs to increase the share of renewable energy substantially as non renewable sources of energy are just not available and U.P. will risk losing growth momentum leading to wide spread inequalities which can have serious social and political ramifications. The India community also needs to understand the challenges being faced by U.P and help by putting in place innovative financial instruments for financing the energy needs of U.P and lifting of technical barriers. Finally, U.P needs to wake up and respond by improving efficiency, boosting infrastructure development and promoting private equity participation as the government cannot raise capital on its own for this purpose. U.P. needs to realize the vast potential of renewable energy and need to step up effort for attaining the goal of "2011 2020" by 2020 i.e. 20% reduction in GHG, 11% reduction in consumption of energy by bringing about attitudinal changes, 20% share of renewable energy and 20% conservation of energy from the year 2011 till 2020. These targets are attainable and not only provide cleaner energy but also open a new field for providing employment opportunities to millions of people who are unemployed or disguised employment. This momentum then needs to be maintained so that U.P attains a target of having 70% renewable energy use by 2050. .

4.11 : ABOUT COMPANY

STERLING AND WILSON POWERGEN PVT.LTD.

(A SHAPOORJI PALLONJI COMPANY)

STERLING AND WILSON POWERGEN PVT. LTD. (SWPPL) and STERLING GENERATORS PVT. LTD. (SGPL) are sister concern and group companies of STERLING & WILSON PVT. LTD. (SWPL) group under the parentage of the renowned SHAPOORJI PALLONJI (SP) family. With 150 years of experience behind them SP Group through Sterling & Wilson made a successful entry in the Power Generation Industry with a premium range of Diesel Generator sets manufactured at the State–of–the-art facility in Silvassa called Sterling Generators Pvt. Ltd. The entire range of DG sets from 10 kVA to 3300 kVA is marked and supported through a nationwide network of sales and service offices and strength of over 500 employees under Sterling and Wilson Powergen Pvt. Ltd. Sterling Generators is our authorized GOEM of Globally reputed engines MTU, PERKINS, VOLVO PENTA,M. POWER, TATA AND ESCORTS.

In a short span of time Sterling Generators has emerged as the preferred choice of quality conscious customers across the country and following landmark installations bear testimony to the same:-

- **Delhi International Airport, Delhi (T3 Terminal) : 14 X 3000 kVA @ 11 KV**
- **Formula One Race Track, Noida : 4 X 3000 kVA & 2 X 1750 kVA @ 11 KV**
- **Delhi Metro Rail Corporation, Delhi : Total 48 sets different ratings**
- **Parliament Annexure Building, Delhi : 3 X 2000 & 1 X 500 kVA @ 415V (UE)**
- **The Supreme Court (New Complex), Delhi : 3 X 2500 & 1 X 500 @ 415V (UE)**

With more than 1700 Gensets having a capacity of 1260 MW operating across India, Sterling Generators is now a dominant player in the DG business in India and has the support of leading business houses in the country. Installations at Delhi International Airport (DIAL), TCS Chennai, CAIRN Energy, VSNL, Infosys, SIEMENS, TATA Steel, SAIL, TOI and many more, are standing testimony of the Project Installation & Service capability of Sterling Generators.

VISION, BELIEF, FOCUS & INITIATIVES

CSR Vision: "Creating a Sustainable and Responsible business"

Our belief:

At Sterling and Wilson, as part of Shapoorji Pallonji Group, we are committed to enriching people's lives. We take pride in being socially and environmentally responsible to our employees, stakeholders, vendors, and the world at large. Every precious resource utilized by us is accounted for and used optimally keeping in mind the greater good of society.

For us, business is as much about integrating societal, economic, and environmental obligations as it is about creating value for our esteemed customers. In our own humble way we strive to be the change we want to see.

Focus Areas of Enrichment:

Our core business is about turnkey contracting in the field of electro-mechanical services. From HVAC, EPC, Solar, manufacturing and assembly of D G sets, HT/ LT panels, fire-fighting, plumbing, to providing customers with operation and maintenance, we cover a wide spectrum of solutions.

Keeping in mind the above functionalities of our business, and our constant engagement with the community; we have identified our Pillars of Sustainable Enrichment as under:

- Improve Quality of Life: Providing Safe Drinking Water, Sanitation, & Overall Health
- Environmental Preservation : Reducing Our Carbon Footprint, Increasing Green Cover, & Promote Bio-Diversity
- Education and Skills Training : Facilitating Underprivileged Children and Young Adults from Tribal Communities with Education and Skills Training
- Inclusion: Training and Earning Opportunity To Differently Challenged Youth, Alleviation Of Poverty, Financial Inclusion For Migrant Labour Force

CSR Initiatives:

SANKALP Programme:

- Adoption of Kalsunpada Village near Silvassa with developmental Plan of 5 years (Project Estimates Rs. 25 L in this fiscal year for our group company SGPL at Silvassa)

Pali Tribal School:

- Enlighten School with power & light by providing Electrical and solar lighting facilities to under privileged children (Project Estimates Rs. 19 Lacs)

Educational Development:

- Donation of Rs. 16 Lacs to SSR College at Silvassa for college development

Uttarakhand Disaster:

- A Sum of Rs. 6.83L was contributed by S & W group employees towards this calamity to PM relief fund. The organization also contributed by matching the total sum contributed by our employees

J & K flood Relief :

- A sum of Rs.23.76L was contributed by Sterling and Wilson group employees towards donating Solar Diya's and Solar Lanterns through our group company Eureka Forbes

Tree Plantation Drive:

- 500 saplings were planted at SGPL factory and nearby schools at Khanvel

Community Care:

- Free Health Checkup camp at Government Hospital near Silvassa Factory
- Distribution of 500 School Kits & 500 pair of Sandals to Mandoni School kids
- Eye Check up Camp
- Blood Donation Camp at Silvassa factory and other branch offices

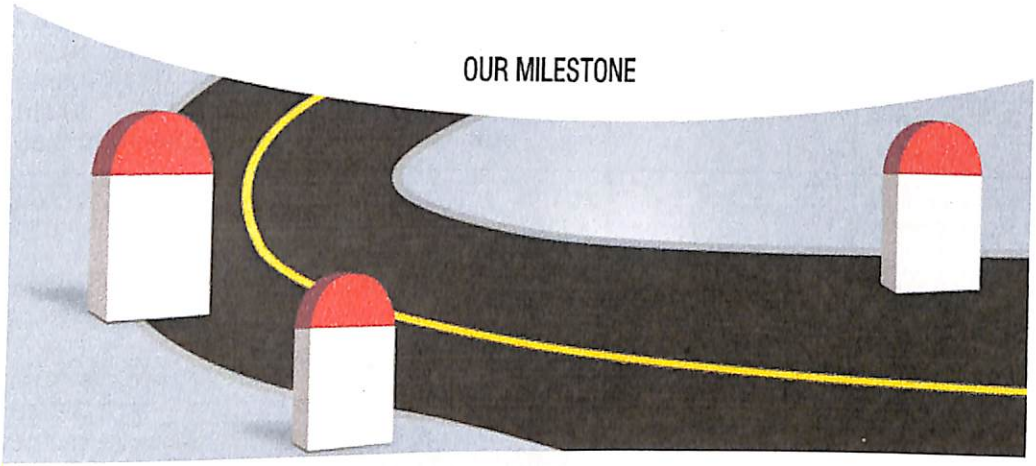
Employees' contribution towards social welfare program:

- Collection of Old Clothes, Books, Pencils for under privileged in collaboration with NGO Green Yatra and Nirmal Education & Health Charitable Trust

Diwali Exhibition:

- Gift Item Exhibition in our office premises during Diwali by NGO's like VOICE , NASEOH & Jai Vakeel

PROJECT REPORT: CAPTIVE POWER - IMPORTANCE, GROWTH & FORCAST



2005 - 2006	Established in 2005
2006 - 2007	Handpicked the best minds and talent for the business
2007	Conceptualised and commissioned Bolted design 65KA, 4000A LT panel, 50KA, 4000A bus duct, Bolted design 75KA,3200A LT panel, IP 55 welded design LT panel
2007 - 2008	Became the largest seller of MTU powered DG sets in Asia
2008	Conceived and created IP 54 bolted design LT panel
2008 - 2009	Became a one stop shop for all energy and power management solution provider for up to 100KA (LT Switchgear)
2009	Started manufacturing IP 54 bus duct, Siemens 11kV and 25KA MV panel
2009 - 2010	Successfully commissioned the largest and most prestigious powerhouse powered by 1500 RPM engines at DIAL/IGIA T3 wherein the infrastructure was designed for 22 x 3000 KVA. The facility now features 14 x 3000 kVA gensets
2010	Started manufacturing 100KA ,4000A PTTA LT panel and type tested LT Panels for Seismic Zone-V
2010 - 2011	Entered into tech transfer agreement with Siemens for up to 12000V switchgear
2011	Type tested 2500A, 415V LT Panels for Seismic Zone-IV • Designed and manufactured 50KA, TTA bolted design LT panel (800,1000,1600,2000, 2500) 65KA, TTA bolted design LT panel (3200) • 100KA, 6300A, TTA LT panel
2011 - 2012	Expanded product range from 125kVA to 3100KVA
2012	Started manufacturing Form 4B LT Panel
2012 - 2013	Expanded product range from 10 - 3100 kVA. Developed a dedicated range of 60 Hz power products
2013	• Began technology partnership with ABB for 12kV,26.3KA MV panel • ABB 33kV, 31.5kA MV panel • ABB 7.2KV, 40KA MV panel • IP-65 LT panel •

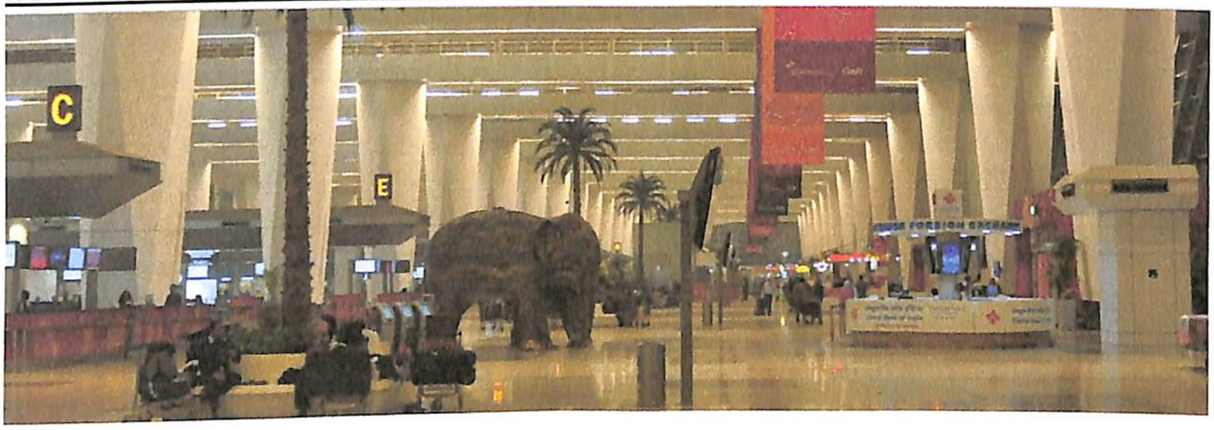
SOME OF PRESTIGIOUS CUSTOMERS:- .

S.NO.	CUSTOMER NAME	PROJECT NAME	LOCATION	DG SETS KVA & NOS.
1	DELHI INTERNATIONAL AIRPORT LTD. (DIAL)	IGI AIRPORT, T-3, DELHI	DELHI	14X3000, 11KV.
2	DELHI METRO RAIL CORPORATION (DMRC)	PHASE – 3, UNDERGROUND STATIONS	DELHI	33X1010 KVA
3	JAYPEE SPORTS PVT. LTD.	FORMULA – 1 MOTOR RACING TRACK, GREATER NOIDA	NOIDA	4X3000, 11 KV 2X1750, 11KV
4	DELHI AIRPORT METRO EXPRESS LINE	DAMEL	DELHI	6X1250 KVA 2X1010 KVA 3X750 KVA
5	AHLUWALIA CONTRACTS (INDIA) LTD.	AIIMS	RAIPUR & PATNA	12X2000, 11KV
6	INTERNATIONAL TRACTORS LIMITED	SONALIKA TRACTORS	HOSHIARPUR	3X2250 KVA
7	S.L. ENTERPRISES	PWD, 200 BEDDED HOSPITAL, ASHOK VIHAR	DELHI	2X1500 KVA
8	L&T LTD.	AIR TRAFFIC CONTROL (ATC), IGI AIRPORT	DELHI	3X2000 KVA
9	ABB LTD.	PGCIL 1X500 MW INDU KORBA	BISHWANATH CHARIALI, ALIPUR DUAR & KORBA	4X1500 KVA 2X1500 KVA
10	RELIANCE ELEKTRIK WORKS	CPWD, BHU, VARANASI	VARANASI	2X1250 KVA
11	S.L. ENTERPRISES	SENA BHAWAN	DELHI	2X750 KVA
12	BORL	BINA REFINERY	MATHURA	1X3000 KVA 1X2250 KVA
13	BHARAT ELECTRONICS (BEL)	BEL – SAHIBABAD	SAHIBABAD	2X1010, KVA 1X500 KVA
14	COFMOW, INDIAN RAILWAYS.	COFMOW – JHANSI	JHANSI	1X2000 KVA
15	COFMOW, INDIAN RAILWAYS.	COFMOW – KAPURTHALA	KAPURTHALA	2X1500 KVA
16	COFMOW, INDIAN RAILWAYS.	COFMOW – DELHI	DELHI	20X160 KVA
17	NATRIP	NATRIP	MANESAR, CHENNAI, SILCHAR	7X1250, 3X625, 1X100, 1X62.5
18	JINDAL POWER LTD.	JPL 2X600 MW AT TAMNAR	CHHATTISGARH	6X2000 KVA
19	TATA MOTORS	PLANT	PANT NAGAR, NAGPUR, SINGUR	7X2100, 6.6 KV 9X1010 KVA
20	BHARTI AIRTEL LTD.	PLANT IN SEC-62, NOIDA AND PHASE – II, NOIDA	NOIDA	12X2000, KVA

S.NO.	CUSTOMER NAME	PROJECT NAME	LOCATION	DG SETS KVA & NOS.
21	IREO PVT. LTD.	IREO VICTORY VALLEY IREO WATER FRONT	GURGAON PUNJAB	2X2250, 1X1500 & 3X1010 KVA (HT)
22	WAVE INFRA	WAVE SILVER TOWER WEST END MALL GEÑESIS GLOBAL	NOIDA JAMMU NOIDA	5X1010, 2X1250 & 1X750 KVA
23	AJNARA	VARIOUS PROJECTS IN NOIDA	NOIDA	21 SETS OF 500, 600, 750 & 1010 KVA
24	ASSOTECH REALTY PVT. LTD.	ABC PROJECT	NOIDA	10X1500 KVA
25	Y. G. REALTY	ONE HORIZON CENTRE	GURGAON	3X2250 KVA
26	TATA HOUSING	RAISIANA RESIDENCY	GURGAON	2X1500 & 2X1250 KVA
27	PARAS BUILDTECH	PARAS TRINITY PARAS IRENE	GURGAON	2X1500, 2X1250, 1X1010 & 1X500KVA
28	PIONEER URBAN	PIONEER PARK	GURGAON	6X1010 & 1X320KVA
29	M3M INDIA PVT. LTD.	M3M COSMOPOLITAN	GURGAON	1X1500, 1X1250, 1X1010 KVA
30	GODREJ	GODREJ FRONTIER GODREJ SUMMIT	GURGAON	3X1875, 3X1010 & 1X500 KVA
31	LARSEN & TOUBRO LIMITED	ATC TOWER, NEW DELHI	NEW DELHI	3X2000 KVA
32	WIPRO LIMITED	UIDAI DATA CENTER	MANESAR	5X1700 KVA
33	HARTRON COMMUNICATION LTD.	BECHTEL OFFICE	GURGAON	6X1010 KVA
34	BANASKANTHA DISTT. CO-OPERATIVE MILK PRODUCERS UNION LTD.	BANAS DAIRY, IMT FARIDABAD	FARIDABAD	2X2000 KVA
35	WHEELS INDIA	WHEELS INDIA LIMITED PLANTS	BAWAL & RAMPUR	10X600 KVA
36	FRUITFILL BUILDCON PVT. LTD	DOUBLE TREE BY HILTON	JAIPUR	3X750 KVA
37	TRITON HOTELS AND RESORTS	TRITON HOTELS	UDAIPUR	3X750 KVA
38	PIEM HOTELS	TAJ VIVANTA	LUDHIANA	2X1010 KVA
39	SIEMENS LTD.	600 MW JITPL FEROZ GANDHI UNCHAHAR THERMAL POWER	ANGUL UNCHAHAR	2X2000 KVA 2X1500 KVA
40	ALSTOM T&D INDIA	SCI-HVDC CHAMPA & KURUKSHETRA	CHAMPA & KURUKSHETRA	2X1700 KVA 2X1500 KVA

4.12 CASE STUDY

PERFORMANCE MONITORING FOR A CAPTIVE POWER PLANT IN T3, DELHI INTERNATIONAL AIRPORT NEW DELHI



PROJECT BRIEF:

The Airport Services Building at the Indira Gandhi International Airport, Terminal 3, has a Test & Integration Centre, together with a state-of-the-art Airport Operations & Control Centre (AOCC), with design inspirations from some of the world's finest airports.
Delhi International Airport is a joint venture consortium of GMR Group, Airports Authority of India, Fraport and Malaysia Airports Holdings Berhad (MAHB). The Terminal 3 was operational in the year 2010 with a capacity to handle 60 million passengers per annum.
Sterling and Wilson was entrusted with HVAC and Electrical works for this building.
Electrical: SITC for Internal & External Works including LT & HT Panels, 2 nos. 1000KVA Transformers, LT & HT Cables, Cable Trays, Earthing & Lightning Protection, Light Fixtures, UPS, Bus duct, DB's, Point wiring, DG, Operation & Maintenance (1 year)
HVAC: The scope involved SITC of Chillers, Precision Air Handling Units, Air handling units, fans, ducting, air distribution products, piping, building management system, MCC, control panels cabling etc.

1. ABSTRACT

The DG Philosophy has been prepared based on following load capacities of the DG banks:

(i) DG Bank 1: 9 MVA (3 MVA x 3 DG Sets) + 6MVA (Future DG sets)
(ii) DG Bank 2: 12 MVA (3 MVA x 4 DG Sets) + 6MVA (Future DG sets)
(iii) DG Bank 3: 12 MVA (3 MVA x 4 DG Sets) + 6MVA (Future DG sets)
(iv) DG Bank 4: 9 MVA (3 MVA x 3 DG Sets) + 6MVA (Future DG sets)

The DGs are designed to operate at a power factor of 0.8 lagging, hence maximum load on each DG will be 2.4MW.

Hence:
Bank 1 & 4 Capacity: 7.2MW (9MVA) each
Bank 2 & 3 Capacity: 9.6 MW (12 MVA) each

□ **BANK OPERATION:**

All the DG sets in one bank shall be synchronized on no-load and shall take maximum load as per DG operating limits/ capabilities. The DGs shall be loaded as per block loading capacity of the DG, which 50% of the generating capacity at any point of time.

□ **BANK TO BANK SYNCHRONIZATION:**

All banks will be synchronized to form a common bus. The details of operation have been mentioned below.

□ **PARALLELING WITH GRID:**

DG sets shall be synchronized with Grid supply for Grid restoration. The grid paralleling, however, will be done only on manual intervention from HMI, permitting the paralleling of grid power with DGs. This will be done with the help of a 'pop-up' confirming the act.

2. SCOPE MATRIX –

2.1 DG Operations: HT DG Control System & AREVA MRSS SCADA(Table 30)

DG Operations	HT DG Control System	MRSS SCADA	ABB Electrical CMS
Individual DG Sets	C&M	M	-
DG Bank Operation	C&M	M	-
Bank to Bank Synchronization	C&M	M	-
Paralleling With Grid	C&M	M	-
Grid Synchronization when Grid Supply Restores	C&M	M	-
DG Auxiliaries	C&M	M	-
Load Sharing between DG Sets	C&M	M	-
Restoration of load	C&M of DG Bank O/G + HT Essential O/G (Soft Command to MRSS)	C&M of HT Essential O/G	C&M of LT breakers
Load Shedding at HT/ LT Level	C&M of HT Essential O/G (Soft Command to MRSS) and dF/dT relay at each Bank	C&M of HT Essential O/G	C&M of LT breakers

TABLE 30 DG OPERATION

C: Control
M: Monitoring

2.2. HT Switchgear / Circuit Breakers Control(Table 31)

DG Operations	DG Control System	MRSS SCADA
HT Switchgear for DG Bank-1	C&M	M
HT Switchgear for DG Bank-2	C&M	M
HT Switchgear for DG Bank-3	C&M	M
HT Switchgear for DG Bank-4	C&M	M
Essential Board -DG Incomer	C&M	M
Essential Board - Trafo Incomer	C&M	M
Essential Board - Bus Coupler	C&M	M
Essential Outgoing Feeders	C&M (Soft Command to MRSS), when DGs in operation	C&M
Tie Breakers between Essential & Non Essential	C&M	M
Non Essential Switchgear	-	C&M

Table 31 : HT Switchgear

3. RESTORATION OF LOAD

This section explains how DG sets can be operated to restore loads as well as how to meet the complete power requirements.(Fig 33)

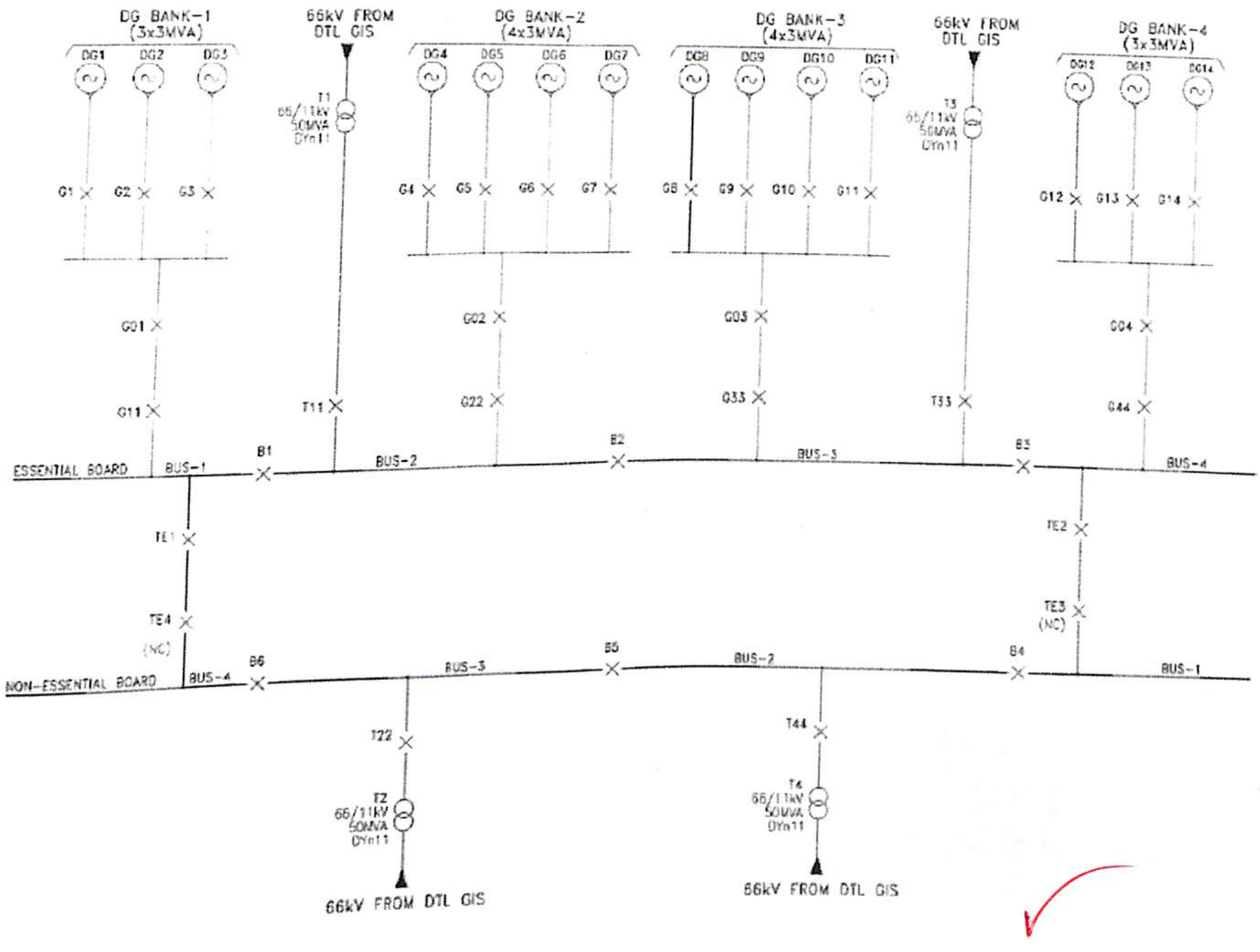


FIG 33: SINGLE LINE DIAGRAM FOR RESTORING OF LOAD

3.1 RESTORATION OF LOAD

➢ **STEP1:**

A) GRID HEALTHY:

Under normal operating condition, T1 and T3 transformers shall feed power to all bus sections (Bus-1 to Bus-4). Breakers position under this mode is shown under.

Condition	Essential											Non Essential	
	G01	B1	T11	G02	B2	G03	T33	B3	G04	TE1	TE2	TE3	TE4
Grid Healthy	O	C	C	O	O	O	C	C	O	O	O	C	C

During this mode of operation, MRSS shall have real time load profile of all the HT Essential O/G breakers. MRSS shall pass the same information to HT DG PLC on real time basis and hence HT DG PLC shall have complete information of connected load on each Essential O/G breakers. It may be noted that Bank-1 and Bank-4 are feeding to PTB PCC's and PIER A/B PCC's and Bank-2 and Bank-3 are feeding to PTB PCC's and PIER C/D PCC's respectively. Information exchange between MRSS SCADA and HT DG PLC will be on IEC- 104.

Besides the above, KW transducers installed in the Essential panel of MRSS will provide real time KW data of the essential sections to HT DG PLC.

B) ESSENTIAL GRID FAILURE / BLACK START:

On grid failure, following simultaneous sequence of operations will be followed.

Final Breakers position after STEP-1 is shown under.

Condition	Essential											Non Essential	
	G01	B1	T11	G02	B2	G03	T33	B3	G04	TE1	TE2	TE3	TE4
Grid Power Failure	C	C	O	C	C	C	O	C	C	O	O	C	C

➢ **STEP-2**

HT DG PLC will issue soft commands to MRSS for closure of HT Essential O/G Breakers in sequence of 1 second ensuring the Block loading on engines are in the specified ranges and total connected load is less than generating capacity at any given point of time. These commands will, however, be given parallel to North and South corridors of MRSS via IEC104 gateway of HT DG Common PLC. The command will be issued to pre- defined breakers as per user configurable priorities. Considering 9 breakers in North corridor and 8 breakers in South corridor to be closed for complete restoration of load, it will take 10 secs to complete the step. Hence total required time for availability of power at PTB and Pier end shall be 30 seconds maximum from AMF failure.

➢ **STEP-3**

MRSS SCADA (on receiving soft commands for closing of Essential breakers from HT DG PLC) will close breakers of the same Essential bus (to supply their respective connected load ensuring total loading on the bus to be 100% of generation capacity.

- **STEP-4**

HT DG PLC will also have real time information of DG generation capacity and consumption of connected load. Based on this, HT DG PLC will now calculate available reserve of that bank and will transfer this information to MRSS SCADA. HT DG PLC shall also ensure only one out of two HT breakers feeding a given substation is switched ON.

In case of any fail to close/tripping of any predefined HT outgoing breaker happens, corresponding identical HT outgoing breaker shall be closed by DG PLC.

HT DG PLC System has now restored all connected loads ensuring that total load on essential bus at any time does not make available reserve negative.

4. LOAD SHEDDING:

The purpose of load shedding is for ensuring feeding of critical Loads in the power system network, by limiting the load upto or less than generation capacity.

Load Shedding will be activated during the following abnormalities in the power system:

- DG Overloading
- DG Tripping

Load Shedding shall be broadly classified in following categories:

1. All bus couplers open. (Bank1, 2, 3, 4 all are running in isolation)
2. Bus-coupler 1 open with bus coupler 3 closed and vice versa (bus coupler 2 open) (Bank1 & 2 in parallel and Bank 3, 4 are running in isolation) or (Bank3 & 4 in parallel and Bank 1, 2 are running in isolation)
3. Bus coupler 2 open, bus coupler 1 & 3 closed (Bank3 & 4 in parallel and Bank 1 & 2 are in parallel)
4. All bus couplers closed. (Bank1, 2, 3, 4 all are running in parallel)

5. DG TRIPPING:

The HT DG PLC will continuously monitor the following critical alarms to initiate priority based load shedding as per philosophy mentioned above, during occurrence of abnormality in any of the running DG :

- Lube oil low pressure
- Coolant high temperature
- Alternator temperature high
- ADEC warning alarm.

6. DIFFERENT POWER SCENARIO:

Operation of DG system under each condition is briefly explained in following sections:

➢ GRID HEALTHY

Condition	Essential											Non Essential	
	G01	B1	T11	G02	B2	G03	T33	B3	G04	TE1	TE2	TE3	TE4
Grid Healthy	O	C	C	O	O	O	C	C	O	O	O	C	C

Load on each Trafo incomer of Essential Board will be monitored by Main PLC through Multi function meter (MFM) provided at each Trafo I/C feeder and the same data will be transferred to MRSS SCADA

➢ T-1 OUT OF SERVICE

Condition	Essential											Non Essential	
	G01	B1	T11	G02	B2	G03	T33	B3	G04	TE1	TE2	TE3	TE4
T-1 Out Of Service	O	O	O	O	C	O	C	C	O	C	O	C	C
T-1 Out Of Service, with TE1 failure	C	O	O	O	C	O	C	C	O	O	O	C	C
T-1 Out Of Service, with B/C-2 failure	O	O	O	C	O	O	C	C	O	C	O	C	C

- ✓ If T-1 out of service is sensed by Main DG PLC. In this case, all HT essential outgoing on bank 1 and 2 will open on under voltage. The corresponding HT outgoing breaker on bank3 and 4 shall be opened by MRSS Scada simultaneously.
- ✓ The HT DG PLC will open B/C1 and close B/C 2. So T-3 power is extended to Bus 2. Once the power is available, MRSS SCADA will close the HT outgoing breakers on Bus 2 as per set priority to feed the load.
- ✓ The Main DG PLC will now close TE-1 and power of T2 (NE) will be extended to Bus - 1. Once the power is available, MRSS SCADA will close the HT outgoing breakers based as per set priority to feed the load.
- ✓ Now, MRSS SCADA shall check the power availability at T2 and T3 and close corresponding HT outgoing breaker at Bus 2 or Bus 3 depending on the availability of spare capacity.
- ✓ In case the TE1 does not close in set time (operator configurable on DG HMI) Main DG PLC will issue start command to DG Bank-1, and power will be made available to Bus -1 by closing G01 from DG Bank-1 PLC. As per load requirement of the bus, all DG's on Bank-1 will be synchronized and put on load. In this case,Bus-1 shall be fed from DG and Bus 2,3 & 4 shall be fed from T-3. MRSS SCADA shall check the power availability of T3 and depending on the availability of spare capacity, close corresponding HT outgoing breaker on Bus 2 of Bus 3. Remaining HT outgoing on Bus 1 shall be closed by

DG PLC based on the block loading and spare capacity philosophy.

- ✓ In Case the B/C-2 does not close in set time (operator configurable on DG HMI), Main DG PLC will issue start command to DG Bank-2 and power will be made available to Bus-2 by closing G02 from DG Bank-2 PLC. As per load requirement of the bus, all DG's on Bank-2 will be synchronized and put on load. MRSS CADA shall check the power availability of T3 and depending on the availability of spare capacity, close corresponding HT outgoing breaker on Bus 3 of Bus 2. Remaining HT outgoing on Bus 2 shall be closed by DG PLC based on the block loading and spare capacity philosophy.
- ✓ Tie breaker TE4 of non-essential board shall always remain in closed position.

➢ T-3 OUT OF SERVICE

Condition	Essential											Non Essential	
	G01	B1	T11	G02	B2	G03	T33	B3	G04	TE1	TE2	TE3	TE4
T-3 Out Of Service	O	C	C	O	C	O	O	O	O	O	C	C	C
T-3 Out Of Service with TE2 failure	O	C	C	O	C	O	O	O	C	O	O	C	C
T-3 Out Of Service with B/C-2 failure	O	C	C	O	O	C	O	O	O	O	C	C	C

- ✓ If T-3 out of service is sensed by Main DG PLC. In this case, all HT essential outgoing on bank 3 and 4 will open on under voltage. The corresponding HT outgoing breaker on bank1 and 2 shall be opened by MRSS Scada simultaneously.
- ✓ The HT DG PLC will open B/C3 and close B/C 2. So T-1 power is extended to Bus 3. Once the power is available, MRSS SCADA will close the HT outgoing breakers on Bus 3 as per set priority to feed the load.
- ✓ The Main DG PLC will now close TE-2 and power of T4 (NE) will be extended to Bus - 4. Once the power is available, MRSS SCADA will close the HT outgoing breakers based as per set priority to feed the load.
- ✓ Now, MRSS SCADA shall check the power availability at T4 and T1 and close corresponding HT outgoing breaker at Bus 4 or Bus 1 depending on the availability of spare capacity.
- ✓ In case the TE2 does not close in set time (operator configurable on DG HMI) Main DG PLC will issue start command to DG Bank-4, and power will be made available to Bus -4 by closing G04 from DG Bank-4 PLC.As per load requirement of the bus, all DG's on Bank-4 will be synchronized and put on load. In this case, Bus-4 shall be fed from DG and Bus 1, 2 & 3 shall be fed from T-1. MRSS SCADA shall check the power availability of T1 and depending on the availability of spare capacity, close corresponding HT outgoing breaker on Bus 1 of Bus 4. Remaining HT outgoing on Bus 4 shall be closed by DG PLC based on the block loading and spare capacity philosophy.
- ✓ In Case the B/C-2 does not close in set time (operator configurable on DG HMI), Main DG PLC will issue start command to DG Bank-3 and power will be made available to

Bus-3 by closing G03 from DG Bank-3 PLC. As per load requirement of the bus, all DG's on Bank-3 will be synchronized and put on load. MRSS SCADA shall check the power availability of T1 and depending on the availability of spare capacity, close corresponding HT outgoing breaker on Bus 2 of Bus 3. Remaining HT outgoing on Bus 3 shall be closed by DG PLC based on the block loading and spare capacity philosophy.

- ✓ Tie breaker TE3 of non-essential board shall always remain in closed position.
- ✓ When T-1 resumption is sensed by Main DG PLC and after permission is given by DG operator, it will open B/C-2 and close T11. So T1 power will feed Bus-2. The Main DG PLC will now open TE1 and close B/C-1 thereby extending T1 power to Bus-1.

➢ T-3 RESUMES

Condition	Essential											Non Essential	
	G01	B1	T11	G02	B2	G03	T33	B3	G04	TE1	TE2	TE3	TE4
T-3 Resumes	O	C	C	O	O	O	C	C	O	O	O	C	C

- ✓ When T-3 resumption is sensed by Main DG PLC and after permission is given by DG operator, it will open B/C-2 and close T33. So T3 power will feed Bus 3. The Main DG PLC will now open TE2 and close B/C3 thereby extending T3 power to Bus – 4.

➢ GRID POWER FAILURE (TOTAL BLACK OUT)

- ✓ In this case system will follow **restoration philosophy** as discussed earlier will be followed.
- ✓ Control of DG Auxiliaries shall be taken care by individual Engine Controllers. Any failure of DG Auxiliary shall be communicated to Bank DG PLC by engine controller.

Condition	Essential											Non Essential	
	G01	B1	T11	G02	B2	G03	T33	B3	G04	TE1	TE2	TE3	TE4
Grid Power Failure	C	C	O	C	C	C	O	C	C	O	O	C	C

7. ROLE OF DG SYSTEM IN DIFFERENT POWER SCENARIO:

➢ Synchronizing Breakers:

Synchronization is matching of three important factors while connecting loads in parallel i.e.

- Voltage (+/- 1%)
- Frequency (+/- 0.1Hz)
- Phase difference (+/- 5 deg)

The voltage, phase and frequency of the synchronizing bus and reference bus should be equal for the paralleling two buses together. DG to DG synchronization within bank shall be done by Individual LSM on each DG's, while Bank to Bank, Non Essential Tie's and Bank to Grid synchronization shall be done by Common LSM's in Main PLC System. Following **table** defines synchronizing breakers of DG switchgear and essential board to be controlled by DG system**(Table 32)**

HT Switchgear	Synchronizing Breakers	Normally Closed Breakers	Synchronization Will be Done By
DG Bank 1	G1, G2, G3	G11, G22, G33, G44	LSM of Respective DG I/C's in Bank PLC **or** Spare LSM in Bank PLC **or** through Manual Synchronization
DG Bank 2	G4, G5, G6, G7		
DG Bank 3	G8, G9, G10, G11		
DG Bank 4	G12, G13, G14		
DG Bank O/G's	DG Bank O/G: G01,G02,G03,G04		Spare LSM on Bank PLC
Essential and Non -Essential	Essential Trafo I/C: T11,T33	TE3, TE4	Common LSM's in Main PLC
	Essential B/C: B1, B2, B3		
	Non Essential: TE1, TE2		

Table 32 Performance of DG set

8. AUTO LOAD SHARING OF GENERATORS

➢ ACTIVE POWER SHARING:

Common terminology used in this:

Capacity (Macap): Maximum Active Power Capacity of Generator up to which generator can be loaded. This will be programmed by operator in the actual capacity of generator, keeping in mind the derating factor of each DG with time.
Generation (Ragen): Running Active Power generation of Generator.
Set-point (SPa): Active Power Set-point of generator. This will be set by operator/Logic and Logic will match generation of Generator equal to this set-point.

Following philosophy will be followed for Active Power sharing under various operating conditions:

Case 1: Diesel Generators are running in parallel. No Grid Supply.
Case 2: Diesel Generators are running in parallel with Grid for Load Transfer.

CASE 1 . Diesel Generators are running in parallel. No Grid Supply.
In this case, capacity of running Diesel generators exceeds total load on the electrical system. Running Diesel generators can cater to load requirement of Plant. Active power sharing will be achieved in following fashion:
An active power set-point will be calculated for all the generators depending on which raise and lower frequency commands will be issued to generator to maintain them within acceptable limit.

The steps followed to achieve active power sharing are:

Calculate the sum of Generation (Ragen) of all running Generators.
Calculate the sum of Capacity (Macap) of all running Generators.

$$\text{Active power ratio Set point for the system} = \frac{\sum(\text{Ragen}) \text{ of running Generators}}{\sum(\text{Macap}) \text{ of running Generators}}$$

Using the active power ratio set point derived above and maximum capacity (Macap) of running Generator, calculate the active power set point (SPa) for all running generators.
Active Power Set-point (SPa) = (Macap) x Active power ratio set-point

Once set-points for main generators are calculated, commands are generated to control speed of generator according to following procedure.

- If Generation (Ragen) of Generator is below the Set-point (SPa) for Generator, generate speed raise command to that Generator.
- If Generation (Ragen) of Generator is above the Set-point (SPa) for Generator, generate speed lower command to that Generator.

Thus Active power sharing is achieved.

When system is running without grid then one precaution has to be taken care that is controlling of frequency of the system. For this a frequency set-point will be given by operator. Frequency has also to be maintained at constant 50Hz.

- If frequency of system falls below 50 Hz then raise speed command has to be given to all running generators.
- If frequency of the system rises above 50 Hz then lower speed command has to be given to all running Generators.

A permissible dead band can be given for all the set-points to avoid continuous fluctuation of Generator parameters.

CASE 2. Diesel Generators are running in parallel with Grid for Load Transfer.

During Planned /Unplanned Grid Failure and Resumption of Grid, DG's need to be run in parallel with Grid to transfer load on Grid. DG's shall be kept in kW Mode. Otherwise, depending on the healthiness of DG's it will be in droop/ kW mode.

During this case all the running DG's which are parallel with Grid will be loaded with a active power setpoint and remaining load will be transferred to Grid. Generation on DG's will be maintained equal to operator set-point (SPa).Once set-points for DG's are assigned, commands are generated to control speed of generator according to following procedure.

- If Generation (Ragen) of Generator is below the Set-point (SPa) for Generator, generate speed raise command to that Generator.
- If Generation (Ragen) of Generator is above the Set-point (SPa) for Generator, generate speed lower command to that Generator.

Thus Active power sharing is achieved.

During this time if we need to transfer the load we will reduce the set points (SPa's) of respective running DG's and load will start to shift to the Grid automatically. Once the load of respective Generator is about 200 kW (Operator Programmable) and system total reserve is capable to take this 200 kW load, open the respective.

➢ **REACTIVE POWER SHARING:**

When active power is shared equally on all the running Diesel Generators, reactive power sharing is easy to achieve.

The steps followed to achieve reactive power sharing are:

Calculate the sum of Active power set-point (SPa) of all running Generators. Calculate the sum of Capacity (Mrcap) of all running Generators.

$$\text{Reactive power ratio Set point for the system} = \frac{\sum(\text{SPa}) \text{ of running Generators}}{\sum(\text{Mrcap}) \text{ of running Generators}}$$

Using the Reactive power ratio set point derived above and maximum capacity (Mrcap) of running Generator, calculate the Reactive power set point (SPr) for all running generators.

Reactive Power Set-point (SPr) = (Mrcap) x Reactive power ratio set-point.

Once set-points for turbine generators are calculated, commands are generated to control voltage of generator according to following procedure.

- If Generation (Rrgen) of Generator is below the Set-point (SPr) for Generator, generate voltage raise command to that Generator.
- If Generation (Rrgen) of Generator is above the Set-point (SPr) for Generator, generate voltage lower command to that Generator.

Thus Reactive power sharing is achieved.

Voltage has also to be maintained at constant 11KV.

- If voltage of system falls below 11KV then raise voltage command has to be given to all running generators. If voltage of the system rises above 11KV then lower voltage command has to be given to all running Generators.

A permissible dead band can be given for all the set-points to avoid continuous fluctuation of Generator parameters.

➢ **AUTO OFF-LOADING AND AUTO SHUTDOWN OF DIESEL GENERATORS**

This package has to automatically off-load the Generators, open the Generator breaker and stop Generator. Once Grid has resumed, after a predefined time interval, offload Diesel generators. During offloading is on, slowly decreasing the load on all off-loading Generator.

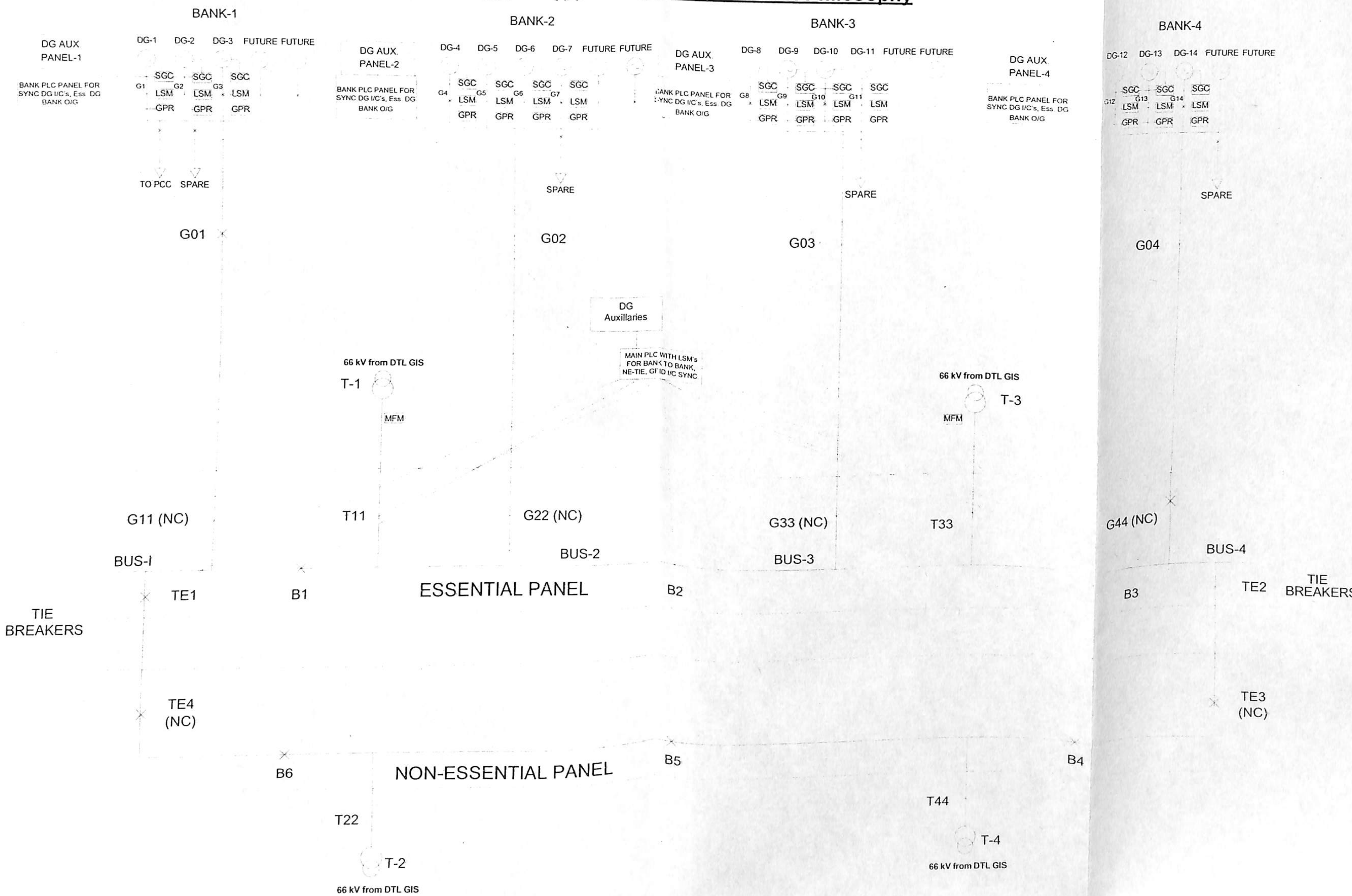
Once the load of Generator is about 200 kW, open the Generator breaker. During this period continue to give speed lower pulse to the Generator so that Generator doesn't go to over-speed while opening the breaker. Maintain frequency and voltage of Generator to 50 Hz and 11 kV and after running idle for 5 minutes, switch off the Diesel Generator.

9. MODES OF OPERATION

- Auto Synchronization Mode
- Manual Synchronization Mode

Selection of Auto/Manual mode shall be done through individual Auto/Manual Selector switches provided on DG Bank Synchronizing Panels and a common switch on common synchronizing panel.

HT DG Control Philosophy



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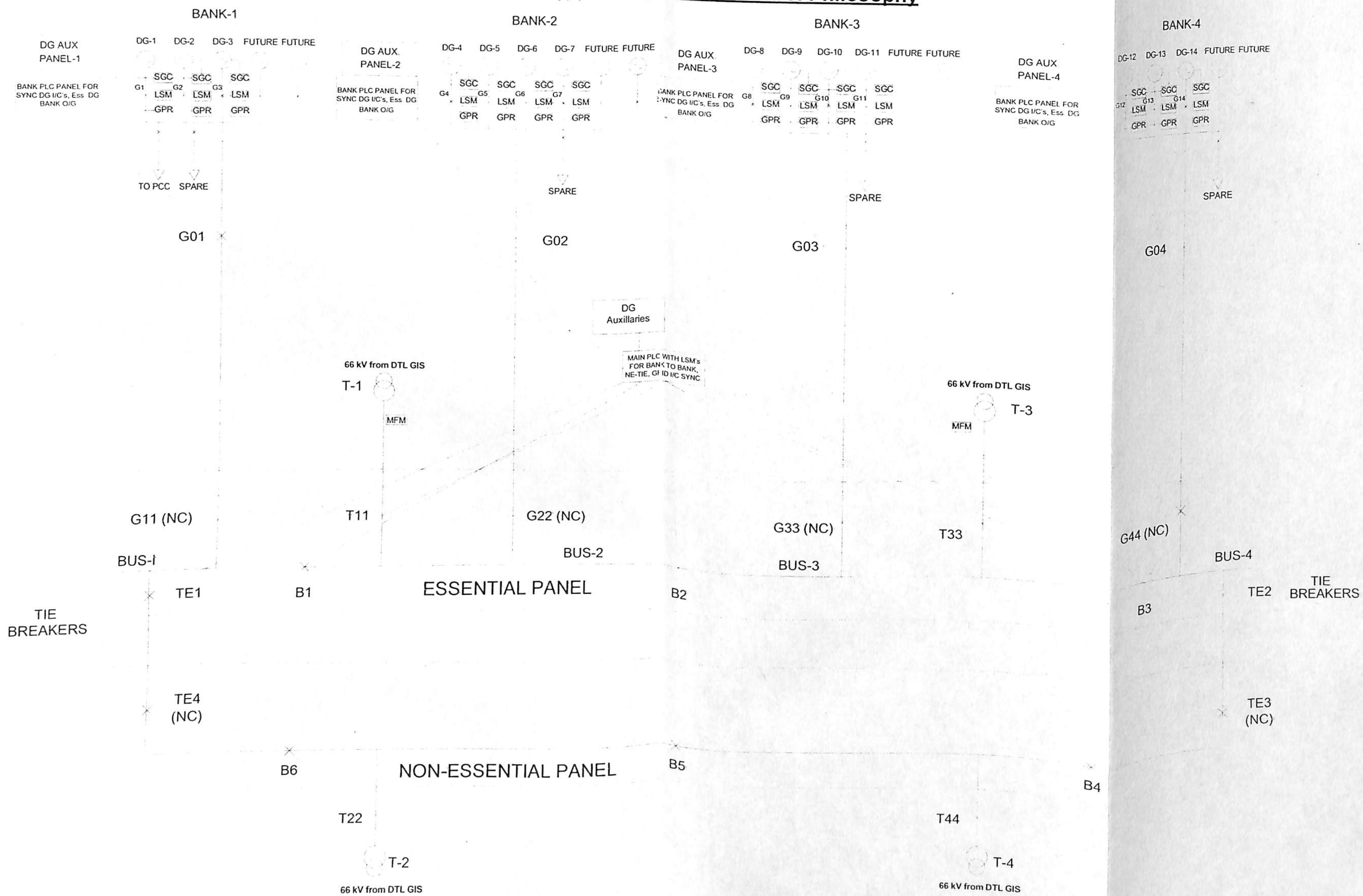
DG Bank 2	G4, G5, G6, G7		
DG Bank 3	G8, G9, G10, G11		
DG Bank 4	G12, G13, G14		
DG Bank O/G's	DG Bank O/G: G01,G02,G03,G04		Spare LSM on Bank PLC
Essential and Non -Essential	Essential Trafo I/C: T11,T33	TE3, TE4	Common LSM's in Main PLC
	Essential B/C: B1, B2, B3		
	Non Essential: TE1, TE2		

NOMENCLATURE

MODBUS COMMUNICATION
CONTROLNET COMMUNICATION
SGC STERLING GENSET CONTROLLER
MFM MULTI FUNCTION METER
LSM LINE SYNCHRONIZATION MODULE

HT DG Control Philosophy



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DG Bank 4	G12, G13, G14		
DG Bank O/G's	DG Bank O/G: G01,G02,G03,G04		Spare LSM on Bank PLC
Essential and Non -Essential	Essential Trafo I/C: T11,T33	TE3, TE4	Common LSM's in Main PLC
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NOMENCLATURE

- MODBUS COMMUNICATION
- CONTROLNET COMMUNICATION
SGC - STERLING GENSET CONTROLLER
MFM - MULTI FUNCTION METER
LSM - LINE SYNCHRONIZATION MODULE

CHAPTER 5: CONCLUSION & RECOMMENDATIONS

CHAPTER 5: CONCLUSION

The study of the captive power plants shows that the CPPs are commissioned by the industries for various reasons. Thus, the CPPs are not a homogeneous in nature. CPPs can be segments into various categories according to the reason for which the industry installed it. The various categories the in which the CPPs can be segmented are- Back up type; CPPs for quality power; CPPs for multiple benefits and CPPs for reducing costs of production of electricity. These categories of captive power plants are fragmenting the electricity generation market of India.

Objective (Segment)	Size	Preferred Fuel	Typical Consumer
Hedging against interrupted power supply (Back Up)	Small	Oil (HSO, FO, LDO)	Small units (Textiles, Paints, Paper)
Better Control and reliable power (Quality power)	Small - Medium	Gas, Naptha	Facilities with sensitive equipments
Joint production of steam and Electricity (Multiple benefits)	Small - Medium	Gas, Naptha, Bagasse	Sugar mills, Cotton Textile
Reduced cost of generation below industrial tariff (Reducing cost)	Medium - Large	Coal, Gas, Naptha	Petrochemicals, Cement

The current captive power plant policy at state and central level treats the CPPs as homogeneous entities. However, there is a need to understand the dynamics of various segments of the CPPs and frame the policies accordingly. The various segments cater to different needs of the industries. Treating these segments uniformly will lead to problems because the varied characteristics (size, preferred fuel type, usage etc.) of these segments.

The study of the CPPs is reveals that the increased commissioning of the captive power plants has various positive impacts and negative impacts on the power sector as a whole. The positive aspects and the negative aspects are not essentially exclusive by themselves. These characteristics give rise to various kinds of tradeoffs at various levels. An effective CPP policy will effectively address these dichotomies and trade-offs.

(i)Reduction of burden of the government to commission additional power plants:

Most of the State Electricity Boards in India are facing a huge financial crisis. In this situation the SEBs are not in a position to commission additional installed capacity. The commissioning by various industries lessens the responsibility of the SEBs to invest in the power sector to certain extent.

(ii) Additional Revenue for the state government:

In many states, the captive power plants have to pay electricity duty for installing captive power plants. In the industries have to pay around 20 to 70 paise 15 per unit to commissioner of electricity for the energy generated from the CPPs. This results in some extra revenue for the State Government.

(iii) Additional revenue for the Transco in the form of wheeling charges:

In many cases the CPPs has to wheel the power to various industries through transmission grids. For wheeling the power, the industries have to pay per unit wheeling charges, which is around 1% to 1.5% of the cost of generation. This results in some additional revenue for the Transco. Though the commissioning of CPPs will lower the burden on the SEBs, will bring in some additional revenue in the form of surcharges and wheeling charges, it has its negative effects also. These trades-offs are:

(iv) Loss of Industrial customers for the State Electricity Boards:

In India industrial tariff is the main source for cross subsidizing the agriculture and domestic users. With the growth of captive power plants, the state utilities are losing these industrial customers and this is affecting the revenue realized by them. Thus, the financial position of the SEBs is getting worse due to the growth of CPPs. In addition, the billing and collection is easier and more efficient in case of the industrial users. This results in lower transaction costs for the distribution companies. Due to the loss of the industrial customers, the Discoms are losing the better customers in terms of the efficient payments.

(v) Adverse environmental impacts arising from types of fuels used and from higher emissions per unit of production:

Many of the captive power plants use oil as fuel. The emissions coefficients of these fuels are much higher in comparison to fuels such as naptha or natural gas. Moreover the distortion created due to high industrial tariffs has prompted the captive plant owners to use the oil based captive plants more since it has become economical for them to run it. This is apparent from the rising plant load factors of these plants, which became as high as 60% in many cases

In spite of a total installed power generation capacity of about 271.722 GW as of end March 2015.India is still struggling to meet increasing power demand. Government of India came up with the Electricity Act in the year 2003 to reform the unorganized power sector in India. EA-2003 has helped to improve efficiency and has brought some much needed order in the overall power sector. However, we are still facing severe power cuts and many regions in India are still lacking something as basic as an electricity connection. Recent structural reforms in the power sector will take some time for complete implementation. In the short to medium term, supply-demand mismatch and limited ability of the financial systems to support subsidies are expected to push consumer tariffs upward. Tremendously growing power demands as a result of sophisticated and materialistic life styles have put the utilities on odds. The utilities are not able to cope with the increasing power demands and also technically it is not possible to erect and operate power plants at the same pace as that of changing power demands. Under such situations, the captive power comes in to picture. Thus, we find that the captive power plants have both positive and negative effects on the power sector. Many states have come up with various captive power policies. However, we need to look at these policies a little more carefully. We need to frame a policy, which increases the overall benefit of the society as a whole.

[redacted] RECOMMENDATIONS

From the national point of view, the issues are somewhat different. Here the objective of the policy maker will be efficient resource allocation. The alternatives differ for short and long runs. In the short and medium run, power cut is given and the alternatives may be to• impose a uniform power cut on industries

- impose an 'optimal' power cut
- minimizing production loss and unemployment
- Allow for captive power generation.

Captive generation is an important means to making competitive power available. Appropriate Commission should create an enabling environment that encourages captive power plants to be connected to the grid.
Such captive plants could inject surplus power into the grid subject to the same regulation as applicable to generating companies. Firm supplies may be bought from captive plants by distribution licensees using the guidelines issued by the Central Government under section 63 of the Act.

The prices should be differential for peak and off-peak supply and the tariff should include variable cost of generation at actual levels and reasonable compensation for capacity charges. A frequency based real time mechanism can be used and the captive generation can be allowed to inject into the grid under the ABT mechanism. Wheeling charges and other terms and conditions for implementation should be determined in advance the respective State Commission duly ensuring that the charges are reasonable and fair. Grid connected captive power plants could also supply power to non-captive users connected to the grid through available transmission facilities based on negotiated tariffs. Such sale of electricity would be subject to relevant regulations for open access.
From July 2003, a new act, the Electricity Act, 2003 has come into force. This act has created tremendous potential for the growth of captive power plants. The provisions like open access, third party sale etc. provided by the Electricity Act, will enhance the growth of the captive power plants. However, on the other hand state has the power of levying surcharges on the industries for the sale of power. This levy might make the third party sale uneconomical. Thus, there is a requirement of balanced captive policy. The captive policy should encourage the industries to look for newer architectures, which are in line with the overall objectives of the reforms such as lowering the cost of generation, more efficient generation etc.
In addition, the regulators should state the long-term industrial tariffs upfront as early as possible so that the various industries do not install CPPs, which might become uneconomical in the end. Finally, there is a need for a well-integrated power policy which addresses the various issues like CPP policy, IPP policy, T&D policy, policy for private investments in power etc. so that captive power investors along with the other stakeholders gain as a whole. This will ensure an overall development of the sector, which will in turn result to development of Indian economy.

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