Captive Power Generation System

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Abstract – Electrical energy plays a vital role in industries. The application include motor drives, electrolytes, process heating, lighting etc .Electricity tariff charged by electric utilities is increased very frequently. Moreover the reliability of supply from grid is very poor. Also industrial sector has to face long power cuts especially during agricultural seasons and other periods of peak demand. In the view of above factors a large number of industries have to switch over to their own generating plants located within their own premises. This method of generation is known as captive power generation and its use is increasing day by day. The electric utilities continue to raise their electricity tariff frequently, Captive power may be cheaper power from grid.

Index Terms – Captive power plant, electricity utility, independent power producer (I.P.P.).

1. INTRODUCTION

Captive power refers to generation from a unit set up by industry for its exclusive consumption. The estimates on captive power capacity in the country vary with the Central Electricity Authority putting the figure at about 11600 MW while industry experts feel that it is much higher, close to 20000 MW 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:

- Poor quality and reliability of grid supply
- High tariff as a result of heavy cross subsidisation

The State Governments and SEBs have been concerned about the growing importance of Captive Power Plants on account of the following reasons:

- Industrial load is the main source for cross-subsidising revenue flows
- 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 cogen plants as a source of firm power

In view of above factors large number of industries has switched over to captive power generation and its use is increasing day by day. Earlier Captive Power Plants were use only as a stand by source of electric supply to field industries when power from grid is not available. However now many Industries generate their total requirements own captive power plants.

2. TYPES OF CAPTIVE POWER PLANT

The captive power plant can be classified as: steam plant, gas turbine plants, diesel engine plant co-generation plant, wind cum plant, hydro plant.

Steam Plants: This choice is suitable for heavy industry e.g. steel aluminum etc. which already have access to coal and the necessary facilities for purchasing and storing coal. Generally these plants are around 100MW or still bigger size. These plants are set up by large size industries. Some industries e.g. sugar industries use bagasses as fuel in their captive power plant. Bagasse is the waste dry sugarcane left over after sugar juice has been extracted. Its use as fuel reduces the operating cost of such captive power plant considerably. Use of fluised bed combustion technology is likely to make the bagasses and other agro waste is the more popular.

Vishakhapatnam steel plant at Vishakhapatnam in Andra Pradesh has a 247Mw capacity coal based Captive Power Plant. SAIL has 302 MW coal based Captive Power Plant at Bokaro (Bihar).

Many Sugar Industries in Andhra Pradesh, Bihar, Gujarat, Haryana, Karnataka, Madhya Pradesh, Maharashtra, Punjab, Utter Pradesh etc., have steam captive power plants using bagasses as fuel. The size of these plants varies from 1 MW to 25 MW.

Diesel Engine Plants: Diesel Engine Plants are by far the largest number of captive power plants. Generally they are used in size of about 1 MW to about 10 MW but sometimes up to 30 MW or so. These plants are use for meeting the total requirements, for peaking requirements as well as stand by plants.These plants have the advantage that they can be run on a verity of liquid fuel, viz., H.S.D .,residual fuel oils ,low

sulphur heavy stock, heavy Petroleum stock etc., other advantages of diesel engine Captive Power plants are:

- Low Capital investment.
- Small space requirements.
- Good efficiency about 40%
- Short gestation period and quick start up time.

Both four stroke and two stroke engine are used. Special advantages of two stroke engine are their ability to run on even residual liquid fuel which is very cheap. Such fuel represents a cost effective option for two stroke engine. Diesel Engine plants are more popular in state of Madhya Pradhes, A.P., Karnataka and Tamil Nadu. Small size diesel engine plants for emergency duty are cost effective option and very popular in small scale industries. Some typical example of such plants are Royal Seema Alkalies Industries (Kurnool, A.P.P) TISCO (Jamshedpur Bihar etc.,)

Co-generation Plants: The efficiency of these plants can be very high thus leading to overall economy and conservation of fuel. A co generation plants may be steam –Gas Turbine plants with waste heat boiler , combine cycle cogeneration plants, biomass fuels plants , diesel engine plant etc., The basic idea is to use as much energy of fuel as possible. The initial cost of cogeneration plant is more bane that of an electrical power plant. However, if the industry requires both electricity and steam, the cost of installation of a separate steam generator is saved. These saving along with high efficiency and lower fuel cost make the co-generation an attractive option. Moreover pollution created by cogeneration plant is lesser than that of other plants.

The potential of co-generation, in India, has been estimated to be about 15000MW. As more industries, come up these potential is likely to be increase. Many State Governments and other organization provide incentives for setting up co generation plants. These factors further enhanced profitability of co-generation plant are being example Arvind Mill (Ahmadabad Gujarat).

Hydro Plants: For industries located near a site suitable for mini hydro plant, this can be a very attractive option. Low gestation period, short starting time , very low operating cost absence of pollution and other benefit make it a cost effective option a 12 MW hydro captive power plant in Kerala and a 10 MW hydro Captive power plants are Karnataka are typical example are these power technology.

Wind cum diesel plant : - If the industries is suited in an area suitable for wind power development a wind electric captive power plant can be very good economical preposition. However a wind plant always has a backup diesel plant to supply electricity need during period of low wind speed.

Wind energy stem have proved to be a viable alternative to fossil fuel based system. If proper sides and favorable wind condition exit setting up a wind energy plant requires huge investment. Moreover such a plant has to be supplemented by diesel plant and batteries. This increases the investment still further. However Central Government and State Government give subsidy and low interest loan to encourage development of own non-convention energy resources.

3. CAPATIVE GENERATION OPTIONS

Captive power generation has a number of options available. Some of these are :

1. Captive power plant for meeting energy requirements of industry and selling surplus energy to neighboring industries.
2. Captive power plant for meeting energy requirement as industry and for selling surplus energy to other industry and utility.
3. Captive power plant set up as a cooperative venture by a number of industries.
4. Captive plant set up as by a generating company and supplying power to many industries in the area.

4. FINANCING OF CAPTIVE POWER PLANTS

The financial aspects of captive power plant are somewhat different from those of utility owned or IPP mega power project. This is because of the reason that total investment is low and return on the investment is not consideration. What is important is that over all generation cost should be lower or atleast comparable with that charged by the State Electricity utility and reliability of electricity supply should be good so that production does not suffer. To a large extent the financing depend on the size of plant.

When the size of plant is less than 5 MW or so , the plant is set up by the industrial owner from his own resources or from borrowing from Banks etc., These is because of the reasons that owner is entitled to claim depreciation and thus save taxes. Most equipment suppliers have a tie-up with Banks and financial institution for grant of loans.

When the size of captive power of is large (more than 50 MW), the plant may be setup by equipment supplier company. Some big equipment supplier views it as an additional avenue for business and profit. In such case the host is not required to make any investment. The plant is designed, constructed and operated by equipment supplier has expertise in design and construction of plant. This option is more economical in many cases.

In all the above case the success of Captivez Power plant depends on following factors. :

1. The financial position and balance sheet of the host company.
2. The proper fuel linkages
3. Proper design, installation and operation of the plant.

The financing is very easy if the Captive Power plant is co-generation plant or a non-conventional source power plant. Subsidies, low interest loan etc., make such plant very attractive option.

5. PROMOTION OF CAPTIVE POWER GENERATION

Most developing countries face short fall in installed generating capacity. One method to counter this short fall is to encourage demand side management. Another is to promote Captive Power generation some measure which promote Captive Power Generation are:

1. Preference to industries setting Captive Power Generation.
2. Preferential allotment of Industrial plots to industries willing to set up Captive Plants.
3. Low interest loan to industries for Captive plant equipments.
4. Help to Captive Power Promoters in arranging fuel linkages. This is the most important aspects since all fuel source /imports in developing countries are owned by Government.
5. Free energy banking facilities
6. Energy wheeling facilities at reasonable rates.
7. Purchase of surplus Captive energy at reasonable rate by utility in the state.
8. Formulation of clear cut Captive power policy by the Government.

6. CAPTIVE POWER PLANT IN INDIA

1. Industries having captive power plant

Cement, chemical, engineering, metal and material, textile, sugar are of industries where captive power generation is very popular. Table shows the % share of different industries.

Industry	% Share
Engineering	20.1
Metals and minerals	19.5
Chemicals	16.8
Textile	10.6
Cement	9.9
Sugar	5.7
Others	17.4

Table 1: Industries having Captive Power Plants

2. Fuel used in captive power plant

The captive power plants are based on steam, diesel, gas and hydel. Smaller plants mostly use diesel. However bigger plants are mostly steam based. Table shows the size range and fuel used

Size Range %	Steam %	Diesel %	Gas/Naptha %	Hydel %
1-5 MW	16	83	1	0
5.1-10 MW	42	56	2	0
10.1-25 MW	35	60	4	1
25.1-50 MW	39	36	25	0
50.1-100 MW	26	21	53	0
100.1-250 MW	70	0	30	-
More than 250 MW	100	0	0	0

Table 2: Fuel Used In Captive Power Plants

3. Captive power plant capacity in some states

Table shows the capacity power plant in some state as % of total all Indian capacity of captive power plants.

State	Installed capacity as% of all India installed capacity of captive power plants
Orissa	12.6
Gujarat	12.2
Madhya Pradesh	10.7
Uttar Pradesh	10.05
Andhra Pradesh	9.95
Tamil Nadu	9.05
Karnataka	8.55
Maharashtra	5.14
Others	26.9

Table 3: Captive Power Plant Capacity in Some States

7. ADVANTAGES

The captive power generation has following advantages

1. The State Electricity utilities are not in position that set up new power plants due to many constraints. As many independent power producer (I.P.P.) are setting up medium and big size power products for supplying power to the state grid. This power is very costly due

2. to high rate of return demanded by I.P.P. Therefore Captive power generation is likely to become an increasingly cheaper alternative.
3. Since the power is consuming within the industries, there are no transmission and distribution losses.
4. The problem of electricity theft is eliminated.
5. Generally there is no extra cost on infrastructure like road, land, etc.
6. Return on equity is not a consideration.
7. The overhead costs are low.
8. The need for state guaranties etc., does not arises.

9. CONSTRAINTS

There are number of constraints in progress of captive power generation system. Some of these are-

1. The industry has to employ skilled personnel to operate and maintain the captive power plants.
2. Purchase and storage of fuel may lead to problems in some cases.
3. Pollution due to small power plants is more than that due to big plants. Use of pollution control measures in captive plants would further increase the cost of captive power.
4. Small size plant is inefficient especially at low load. This may aggravate the fuel and oil crises if captive power plant are installed and used in a big way.

10. CONCLUSION

Resource assessment, technological Appropriateness and economic feasibility are the basic requirement of project evaluation. The captive power generating systems can play a major role towards the fulfillment of energy requirements of industry.

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