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NECESSITY OF CAP TIVE POWER PLANT AND STUDY ON WASTE HEAT RECOVERY PROCESS

Chedde Sreevani, Banoth Devika
Student of Embedded Systems, Department of Electronics and Communication Engineering
Jawaharlal Nehru Technological University, Hyderabad

Abstract: The advancement of a country is measured in terms of per capita consumptions of electrical energy. In this modern world, the dependence on electricity is so much that it has become a part of our life. The ever-increasing use of electric power for the domestic, commercial and industrial purposes necessitates to provide electric power economically. This necessitates fast and economic planning tools to evaluate the consequences of different proposed alternatives and their impact on the rest of the system to provide the necessary economical, reliable and safe electrical energy to consumers. Therefore, it necessitates to have captive power plant (CPP) in an industry. Sponge Iron India Limited (SIIL) joins a better example for this. In this paper I have explained the waste hear recovery process for power generation. I also studied about the fluidized bed combustion boiler. I have explained the control parameters involved in boiler protection and effect of these control parameters on the generator output is also presented. I also studied and presented about the Brushless Excitor in which voltage control process is by Automatic Voltage Regulator (AVR) and speed governing mechanism frequency control. I analysed about two modes of plant operation synchronous mode and solo mode.

Keywords: Captive Power Plant, Automatic Voltage Regulator, Waste Heat Recovery Process, Brushless Excitor.

1. **INTRODUCTION:** A lot of churning is going on in the ministry of power to revamp the power sector. According to National Power Development Plant prepared by Central Electricity Authority (CEA) in 1991 covering up to the Tenth Five Year Plan period, the additional generating capacity by the year 2006 – 07 as to be 1,42,000 MW. The plan identifies projects totalling 56,783 MW in the Ninth and over 60,000 MW in the Tenth plan. The power utility in India, on account of historical reasons, has developed in different ways over the past 100 years. The first power plan of 130 KW was commissioned in the 1880's at 'Darjeeling' and with those hydroelectric plants began the supply of electricity in the country. The first coal-based thermal power plant was set up at Calcutta in 1897. For the next 50 years electricity supply was mainly confined to urban areas, and chiefly for lighting purposes. In 1947 the total installed capacity of electricity was mere 1,362 MW. It is more than sixty-fold to 81,164 MW in 1995. At independence the per capita consumption of power was less than 15 units which rose to the 314 units over the same period. The shortfall between demand and availability of power in India from 1992-93to 2002-03 is as show below:

table 1.1

Year	Short fall (MW)
1992-93	10,821
1993-94	10,045
1993-95	59,464
1995-96	11,857
1997-98	12,510
1997-98	13,194
1998-99	13,914
1999-2000	14,668
2000-01	15,461
2001-02	16,291
2002-03	17,163

The total investment required in the power sector over the next decade is estimated to the tune of Rs. 6,24,400 crores to generate as much as additional 142,000 MW of power. India is a resource – rich and possesses enormous thermal and hydel resources. But to utilize these resources, cost effective technologies have yet to be developed. Domestic consumers cannot generate the power but the industries which are using high amount of power have some resources in the form of waste gases etc, so the industries must try to generate power and try to balance the shortfall. By locating the captive power plants, we can avoid power interruptions. They also reduce the cost per unit power to about 25%. As a model to the above, M/s Sponge Iron India Limited (SIIL) have developed and established its own plant to meet its power requirements and a study has been made elaborately and explained in this paper.

3.THE CONCEPT OF POWER PLANT:

SIIL has taken up the task of improving the process particularly in the field of Energy Conservation. The studies revealed (ref. Fig 3.1) that about 27% of total heat carrying away by the gases and about 17% of total heat is going in the form of waste products, char and dolochar. About 30 tons of char and 10 tons of dolocar having heat values 2900 and 2100 k.cal/Kg respectively are being produced everyday from each DR plant. The idea of power generation was conceptualized to utilise these heat resources and to improve the overall efficiency of the total plant.

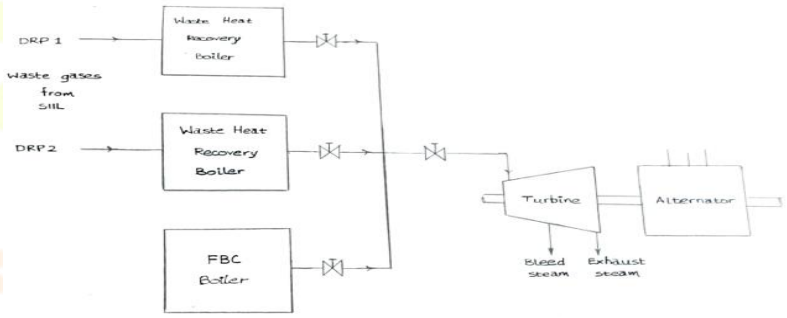

fig 3.1 captive power plant

Based on the above concept, a 5.5 MW capacity power plant was set up and commissioned in 1993. Initially 3.0 MW power generation was envisaged with the steam of two Waste Heat Recovery (WHR) Boilers and later, to utilise excess capacity with the steam of Fluidised Bed Combustion (FBC) Boiler based on waste products. In first phase two WHR Boilers of 11.23 tph capacity each and one 5.5 MW capacity Turbo-Generator set were installed and commissioned. After overcoming all teething problems in the first two years of operations, the plant was stabilised with 2.0 MW load. The deviation from the original estimate is due to variation in quality of coal used in DR plants. The percentage of ash is directly affecting the gas temperature (ref. Table 3.1), which in-turn affecting the generation.

table3.1

ASH CONTENT IN (%)	GAS TEMP (*C)
27	1000
30	875
35	825
40	800
45	775

In the second phase an FBC Boiler 15tph capacity is installed to generate 2.5 MW power. It is designed to utilize the solid wastes char, dolochar and coal fines as fuel. The total amount invested in these two phases is about Rs. 14 Crores. Because of this low investment at Rs. 2.55 Crore per MW, low cost of capital and low fuel cost is making the Power Plant highly profitable. The unit cost will be Rs 1.50 at full-load operation.

The future requirements and supplies are given in table 3.2

TABLE 3.2

POWER REQUIREMENT FOR	IN Mega.Units
DR PLANTS	6.5
POWER PLANT	4.5
SUBMERGED ARC FURNACE	36.0

4.CONCLUSION:

The Captive Power Plant(CPP) has proved to be reliable.It paves a way for reduction in cost per unit and also for uninterrupted power supply.As the process here is Waste Heat Recovery process no fuel is used and hence economical.Even in Fluidized Bed Combustion Boiler. The coal used as fuel is the waste obtained from Sponge Iron Process. The methodology for governing the control parameters of boiler and generator output is online computer controlled. The excitation to alternator is provided by Brushless excitor, which proved to be reliable, and requires least maintenance. The speed governing system for frequency control provides an accurate control. Though the plant capacity is small the cost per unit production is less because the fuel cost is almost nil. The power plant showed a marked difference in increase of profits of SIIL, after its location and it is really a beacon for the future. The plant can further be improved by adopting Circo Fluidized Bed Combustion process where in 100% of cost is combusted.

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