Co-Generation Plant at TNPL

Kuppusamy K. Chandrasekhar G.

Tamil Nadu Newsprint and Papers Limited, Kagithapuram-639 136 Dist- Karur (T.N.)

ABSTRACT

Co-Generation is the simultaneous production of two or more forms of useful energy, usually electricity and heat, from a single source. Co-generation applications of priority interest are in the Pulp & Paper and Sugar industries where lot of power and heat energy is required for its processes. Technologies and practices have been developed further to improve overall plant thermal efficiency and reduce capital costs for process industries of all kinds. This paper outlines how co-generation has helped TNPL to improve the bottom line by reducing the power cost which constitutes about 25% of cost of finished goods (paper).

INTRODUCTION

Tamil Nadu Newsprint and Papers limited, is the largest bagasse based integrated pulp and paper mill in India with an installed capacity of 180,000 tonnes per year. The mill has the facility to manufacture both newsprint and printing and writing papers using bagasse as the principal fibre source with 75% bagase pulp and 25% wood pulp furnish. Paper industry being energy intensive, envisaging global competition, high costs of purchased power and concern for environment, TNPL has attached more significance to the co-generation. The steam generated from the boilers is passed through the turbines to extract process steam for papermaking and to generate electricity both for sale to Electricity Board and for self-consumption (Fig. 1 and 2).

Developments in TNPL on Co-generation

In 1985 along with first phase of TNPL with 300 tpd paper capacity the mill commissioned three Ignifluid Boilers of steam generation capacity of 60 TPH each at 44 Kg/cm^2 and 440°C, supplied by M/S Fives Cail Babcock, France and two Turbo Generators of 18 MW (extraction and condensing type) and 8 West Germany. TNPL has two Soda Recovery Boilers of one with capacity 34.6 TPH at MCR that can fire around 285 MT of black liquor solids per day and the other Boiler of capacity 45 TPH at MCR and can fire 375 MT of black liquor solids per day. TNPL was drawing about 250 lakh units/annum from the State Electricity Board and In-house generation was around 1200 lakh units/annum upto 1994-95.

TNPL has diversified into the field of Non-conventional energy sources, for generation of electricity. Under this programme, the company has set up a 15 MW Wind Farm in Tamil Nadu at a total capital outlay of Rs. 50 crores. The wind farm is located at Kayathar and Perungudi wind belts of Tirunelveli district. This wind farm was comissioned in March 1994. TNPL has recently expanded the capacity of the wind farm by adding 4 No. of 750 kW Wind electric generators, taking the Wind farm capacity to 18 MW. The credit from the wind farm is around 180 to 200 lakh kWh/annum. At present entire power is exported to the State Electricity Board Grid.

In 1995 when TNPL went in for doubling the capacity of the plant from 300 tpd to 600 tpd, added one atmospheric fluidised bed combustion type (AFBC) boiler of 60 TPH at 44 kg/cm^2 and one 10.5 MW Turbo - Generator set with double extraction at 11.0 kg/sq. cm g & 4.0 kg/sq. cm g and condensing type both supplied by M/S BHEL was added. The idea of going in for atmospheric fluidised bed combustion type (AFBC) boiler was to fire Raw Lignite which was cheaper and available in the nearest source at Neyveli and also low calorific value fuels such as coal, bagasse pith, agro wastes etc. in any combination can be used thereby avoiding the disposal problems of waste process pith, effluent waste, wood dust etc. generated in the plant. AFBC boilers are specially designed for the high ash content Indian coals, to get maximum efficiency.

After stabilizing the second phase the demand for power was around 3000 lakh unit per annum. TNPL's In-house generation was 2200 lakhs unit per annum

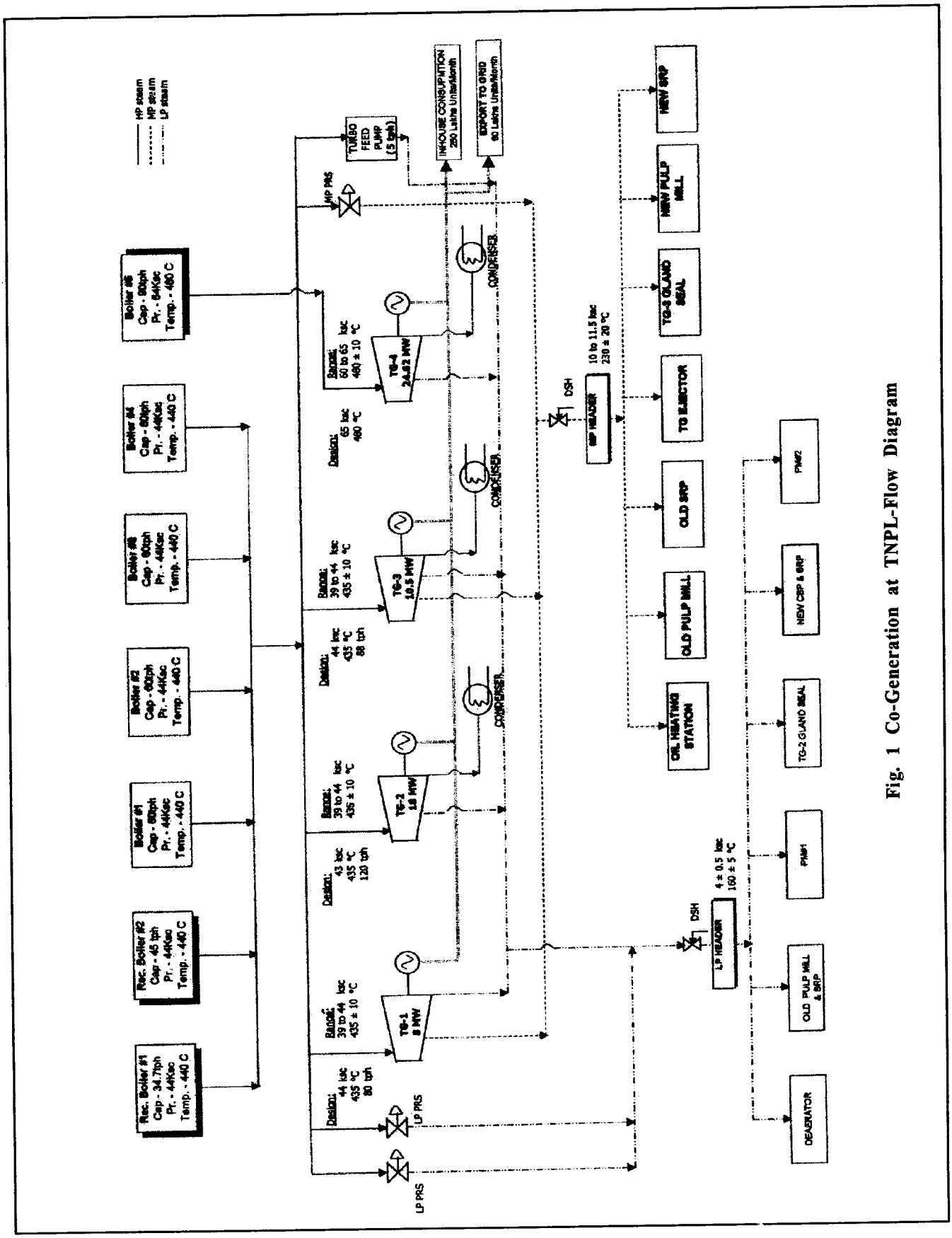

Fig. 1 Co-Generation at TNPL-Flow Diagram

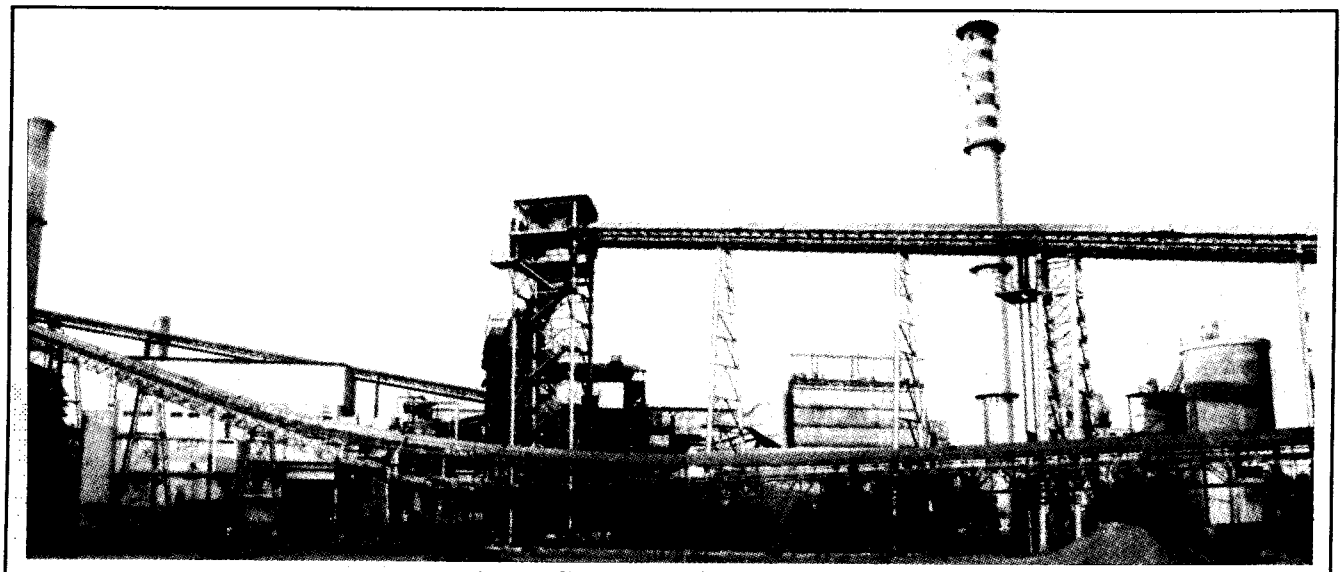

Fig. 2 Co-Generation at TNPL

at the cost of Rs. 1.50/unit and the balance of 700-800 lakhs units per annum was drawn from the State Electricity Board at the cost of Rs. 3.50/unit. The average cost of power was around Rs. 2.20/unit due to the increased cost of the power drawn from the grid. The total steam generation per day was around 4000 MTs of steam from Power Boilers and 1500 MT of steam from the Soda Recovery Boilers of which the process steam requirement for the plant was 3900 MT of steam per day and the balance steam was condensed for power generation. With the above arrangement the energy bill was around Rs. 30 crores per annum.

To further increase the in-house generation for reducing the average cost of power and avoid dependence on grid TNPL utilizing the huge infrastructure of fuel handling plant to handle 5 lakh tonne per annum of coal with a wagon tippler and a good railway network connecting Chennai and Tutocorin port, went in for an addition in Co-Generation of 24.62 MW with a capital outlay of Rs. 50 crores (Fig. 3). For firing complete pith generated from various sources and other organic waste generated inside the plant, TNPL installed one more AFBC boiler of 90 TPH at 65 Ata supplied by M/S CVL, Trichy and a Turbo Generator of 24.62 MW capacity with extraction at low steam pressure of 4.5 kg/sq. cm g and condensing supplied by M/S BHEL taking high pressure steam, from the Boiler plant at MCR conditions of 64 kg/sq cm g at 485 C. After commissioning the 24.62 MW TG set in May 2001 and stabilizing the generation in July 2001, TNPL is self sufficient in power besides exporting the surplus power to the State Electricity Board and the average cost of power is only around Rs. 1.45/unit.

Cost Savings

At present imported coal from Indonesia is the cheapest fossil fuel with less ash content and is utilised to the maximum extent in all the Boilers. TNPL has started using agro fuels like paddy husk, coconut shell, coffee husk, saw dust, wood chips etc. depending on the availability from 2001-02. With the modest usage of 6552 Mt of agro fuel in 2000 -01 to start with, the quantity has increased to 13387 Mt in 2001-02. For the year 2002-03 the target has been set at 20000 MTs.

The total steam generation per day is around 6000MTs of steam from Power Boilers and 1400 MT of steam from the Soda Recovery Boilers. The process steam requirement for the plant is 1150 MT of steam at 11 kg/sq. cm g and 2950 MT of steam at 4 kg/sq. cm g. The total process steam requirement for the plant per day is around 4100 Mt per day and the balance steam of around 3300 is condensed for power generation.

The mill has total installed capacity of 60 MW which constitutes one No. 18 MW, one No.8 MW, one No. 10.5 MW and one No. 24.62 MW. The details are shown in Tables 1-4.

The real life line for TNPL is installation of 24.62 MW TG set which has enabled TNPL to reduce the contracted maximum demand from 30 MVA to 10 MVA in phased manner, export 60 lakh units per month to the State Electricity Board besides being

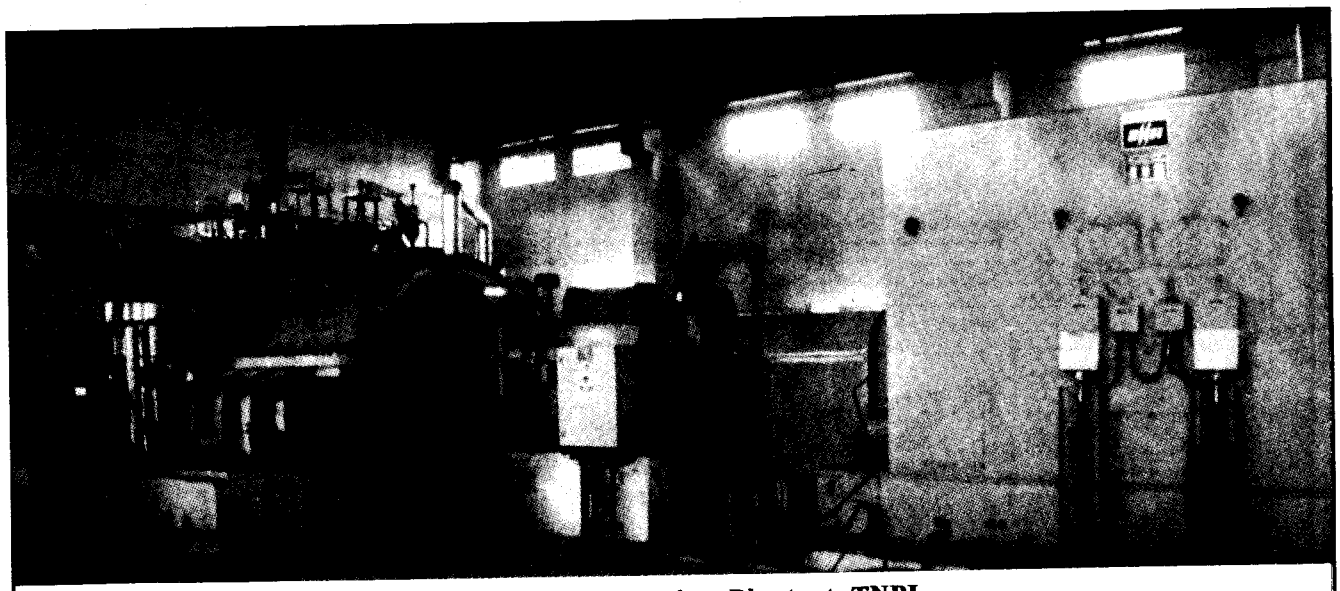

Fig. 3 Co-Generation Plant at TNPL

self sufficient in power for the complete mill operations. The overall unit cost of power as of today is about Rs. 1.45 from the earlier level of Rs. 2.20. The overall cost of steam per tonne has also come down to the present level of Rs. 420 per MT of steam.

Energy Conservation in Co-Generation Plant

Additional dust collector was introduced in the Ignifluid Boilers to improve the collection of unburnt carryover in the fly ash which increased the boiler efficiency by 0.5%. New economizer with higher heating surface area was installed in two of the Ignifluid Boilers to reduce the flue gas outlet temperature from 170°C to 140°C and thereby increasing boiler efficiency by 1%. Changing of the economizer coils for the same purpose in the third Ignifluid Boiler will be completed by May, 02.

Polyamine is used for conditioning of feed water to ensure prevention of corrosion and scaling in the Boilers. Polyamine is a volatile which does not have dissolved solids. (The chemical used is Eloguard supplied by M/S Elof Hansson). This has reduced the blow down to less than 1% of the total generation.

For pulp making process Bagasse fibre is the major raw material. Bagasse pith which is separated from the fibre in depithers, otherwise a waste, is fired in the Boilers. Earlier, process pith from pulp mill and the bagasse clarifier underflow material blended with MLSS, from ETP which was being dumped outside as waste. By installing screw presses complete process pith from pulp mill at 85% moisture was brought to the level of 60% and is directly used in the Boilers and the MLSS is sum dried and used. This pith

Table 1.Turbo Generator # 1

Type:	Extraction and back pressure type		
Capacity:	8 MW		
Supplier:	M/s Siemens AG, West Germany,		
Inlet steam	Pressure	kg/sq cm g	43
	Temperature	°C	435±10
	Live steam flow at MCR	TPH	82.5
Pass-out	Pressure	kg/sq cm g	11±1.0
	Maximum flow	TPH	40
Back pressure	Pressure	kg/sq cm g	4±0.5
	Maximum flow	TPH	60
	Average flow	TPH	45

Table 2.Turbo Generator # 2

Type:	Extraction and Condensing		
Capacity:	18 MW		
Supplier:	M/s Siemens AG, West Germany,		
Inlet steam	Pressure	kg/sq cm g	43
	Temperature	°C	435±10
	Live steam flow at MCR	TPH	122
Pass-out	Pressure	kg/sq cm g	4±0.5
	Maximum flow	TPH	90
	Average flow	TPH	55
Condenser	Out put fully condensing	MW	16.5
	Average steam flow	TPH	25

Table 3.Turbo Generator # 3

Type:	Double Extraction and Condensing		
Capacity:	10.5 MW		
Supplier:	M/s BHEL		
Inlet steam	Pressure	kg/sq cm g	43
	Temperature	°C	435±10
	Maximum steam flow	TPH	88
	Normal steam flow	TPH	88
Pass-out # 1	Pressure	kg/sq cm g	11±0.5
	Maximum flow	TPH	45
	Normal flow	TPH	10
	Minimum flow	TPH	0
Pass-out # 2	Pressure	kg/sq cm g	4±0.5
	Maximum flow	TPH	70
	Normal flow	TPH	70
	Minimum flow	TPH	0
Condenser	Out put fully condensing	MW	6.8
	Average steam flow	TPH	35

including pith from depithers, pith screw press and MLSS otherwise waste totaling about 86759 MT was fired in the Boilers during 2001-02 saving about 20,000 MT of fossil fuel of value Rs. 450 lakhs.

Fly Ash Utilization and other Environmental Factors

About 35000 Mt of fly ash generated from the Boilers of which about 95% is lifted by the cement plants. The quality of fly ash has been improved by bringing down the LOI % suitable for cement plants. Some of the cement plants are using it directly for mixing it in the finishing stages and in Dalmia Cements, fly ash is used even at the feed of the process and is mixed up with the raw materials for alumina correction.

CONCLUSION

TNPL has adopted usage of bagasse pith (waste materials from sugarcane bagasse fibre) and agro wastes whose cost was very minimum. At present in all the boilers coal imported from Indonesia being cheaper is utilised to the maximum extent. TNPL has started using agro fuels like paddy husk, coconut shell, coffee husk, saw dust, wood chips etc. depending on the availability. This has resulted in bringing down the cost per tonne of steam generated from the boilers and also unit cost of electricity to Rs. 1.45 /Unit compared to the EB power cost of around Rs. 4.0/Unit. TNPL could sustain its viability even with

Table 4.Turbo Generator # 4

Type:	Extraction and Condensing		
Capacity:	24.62 MW		
Supplier:	M/s BHEL		
Inlet steam	Pressure	kg/sq cm g	62
	Temperature	°C	480±10
	Maximum steam flow	TPH	90
	Normal steam flow	TPH	88
Pass-out	Pressure	kg/sq cm g	4.5±0.5
	Maximum flow	TPH	30
	Average flow	TPH	20
Condenser	Out put fully condensing	MW	24.62
	Average steam flow	TPH	90

the increase in the cost of purchased power and input raw materials such as coal, lignite and other fuels mainly due to implementation of captive co-generation concept. Today TNPL is self sufficient in power by increasing power generation and exporting power to the State Electricity Board which is targeted at 7 crores units per annum. Also the power generated from the windmills is around 250 to 280 lakh kWh/ annum and is sold to the TNEB at Rs. 2.70/unit, increasing the profit margin of the company.

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