Energy Management and Cogeneraion of Electrical Power in Andhra Pradesh Paper Mills.

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ABSTRACT : This Paper deals with efficient and Economical use of cogeneration plant and various measures taken on Energy conservation activities and their impact in conserving energy in terms of power, coal and water. The installation of cogeneration plant and conservation of Coal fired boilers into Fluidiused bed combustion system are most economical for power generation and coal consumption.

Energy Scenerio

Historically, energy prices were low as compared to other critical inputs to the production. However during seventies, when the world had witnessed energy crunch, the desire of reduction in energy consumption became a necessity for bulk power consuming industries like Pulp and Paper Plants.

In India the scope for efficient energy production and utilisation has been established soon after steep hike in oil prices in the world market.

Due to old equipment/ technology and heavy investment involved for revamping on the entire energy generation plant, progress on effective energy generation & utilisation had been rather disappointing. Since the industries using steam for process application has to invest in boilers, the scope for cogeneration steam heat and power is fuel efficient and low cost power generation.

Paper industry is one of the major power consuming industry. Out of the total input costs for making paper 20% cost goes for fuel and power. Energy requirement are met in paper industry from a) National/State Power grid b) Self generation through steam turbine. Any deficit of power from State grid quota and from self generation are normally met by Diesel Generator sets.

Co-Generation

Any power, plant producing steam for process application is when used simultaneously for power generation too is called co-generation plant. In paper industry wherein MP & LP steam is required for wood chips pulping process and paper drying process, is the best suited for co-generation application. The steam produced at higher pressure (normally 30-40 Kg/Cm^2) is passed through the steam turbine and MP/LP steam extracted from turbine is used for process application while power generation becomes bye product. The power generated through co-generation thus becomes one of the most economical.

APP mills had three turbines i.e.

	MP	LP	Cond.	Load.
i) Double extraction turbine	10T/hr	52T/hr	-	4.0 MW
ii) Back pressure turbine	-	10T/hr	-	0.8 MW
iii) Pure condensing type turbine	-	-	20T/hr	4.0 MW

Inspite of two turbines available to operate on process steam requirement, we had to pass minimum 41 T of steam through pressure reducing station.

To curtail the energy loss in pressure reducing station, we have gone for single turbine of 10.0 MW capacity with double extraction cum condensing facility. By commissioning new co-generation set we could process entire process steam through turbine for tapping heat energy from steam for power generation as a by-product.

The heat load and electrical loads are seldom exactly the same. When the heat production matches the process heat requirement, at times the electrical output will be less than the process requires and the other times will exceed the steam required at a particular temperature and pressure. By selecting double extraction cum condensing type turbine, we could choose condenser capacity in such a way that during change in steam demand by the plant, condenser of TG could take care of power demand by the plant.

Condensing power is costliest in cogeneration. Unless alternative scheme and controls are engineered and incorporated properly, it is not possible to run co-generation plant economically. To run the TG set with minimum

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condensing concept, we have gone for parallel operation facility with state grid power. By virtue of this facility condensing power is always floated along with imported state grid power at mimimum steam condensing control setting. To avoid any disturbance on our own Turbo generator set due to violent variation in state grid power supply i.e. in voltage & frequency, auto "load through" arrangement with generator is landing with its predetermined load of the plant is made.

APP Mills, which had unit energy consumptions like 1752 KWH/T of paper, 1.95 T coal/T of paper and water 368 M^3/T of paper in 1985-86 had been brought down to 1524 KWH/T of paper, 1.49 T Coal/T of paper and water 321 M^3/T of paper in 1990=91. At present power consumption per tonne of paper is around 1650 KWH due to additional equipment provided for effluent treatment plant.

The Cutting of energy supply is not deliberate act for conservation but is consequence of the measures effected in saving money for the same level of production, conserving energy through increase in equipment and operational efficiency and by minimising the wastages. Hence with this philosophy M/s. Andhra Pradesh Paper Mills had changed its strees from " POWER DEMAND & DISTRIBUTION MANAGEMENT" to "ENERGY CONSERVATION MANAGEMENT".

For the purpose of energy conservation our activities were grouped in three categories.

a) SHORT TERM MEASURES: C - CLASS SCHEMES

Under Short term measures, those schemes were picked up for which meager amount of investment was required. The schemes were implemented with the aim to achieve immediate goals set for saving energy.

B) MEDIUM TERM MEASURES : B - CLASS SCHEMES

Under Medium term measures, we took up those schemes, which required moderate amount of investment with an aim to achieve the results within a year.

C) LONG TERM MEASURES : A - CLASS SCHEMES

Under Long term measures we covered those schemes which needed high investment with very attractive pay back period. All these schemes were covered under A- Class category and were completed within two years.

a) SHORT TERM MEASURES : C - CLASS SCHEMES

Saving of energy through efficient use of air compressor & air distribution system.

Like most of the industrial plants, we too had battries of air compressors located at one central plant. All the compressor were set for 7.0 Kg/ Cm^2 air pressure which had been carried to different location through length, pipe lines and throttling valves/pressure reducers.

Most of the instruments/cylinders of our mills operate at 6.0 Kg/Cm^2. Pressure. However, ODS pumps of white liquor and mud washer filters operate at 4.5 Kg/Cm^2. We isolated two compressors and made them dedicated for ODS pumps. Only one compressor was run and other was used as standby. By making alteration in pressure and air distribution system, we could save 850 KWH/day.

We have also made study on capacity utilisation from each compressors through compressor manufacturer. We have found that FAD for source of the compressor is as low as 60% of their capacity. To improve the capacity of such compressor complete overhauling is being planned.

Saving of energy by reducing torque transmission losses belt driven equipment

Conventional 'V' belt are 83-86% energy efficient i.e. 14-17% of power fed to the 'V' belt for torque transmission is lost in it. Due to continuous improvement in quality of material and design flat belt up to 98% efficiency are available. To curtail the transmission losses in V-belt driven higher capacity (KW), selected equipment were made to run on flat-belt drive. Through flat belts transmission schemes, we could save about 12% energy loss from V-belts.

Total saving of power = 3.8 Lakhs KWH/Annum. (Fig. 1)

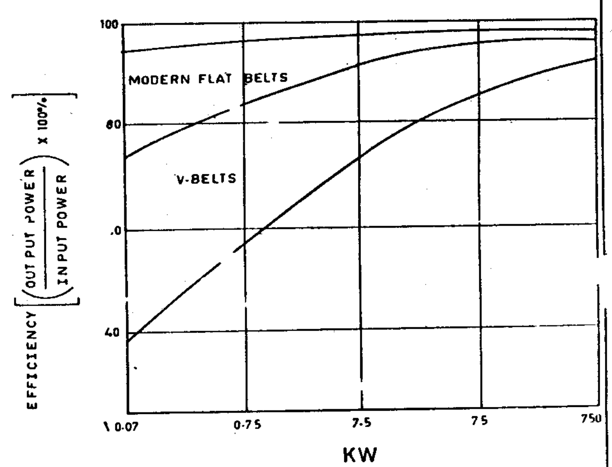


Figure.1

RELATIVE EFFICIENCIES OF MODERN FLAT BELTS AND V BELT DRIVES PLOTTED AGAINST INPUT POWER AS BASED ON ACTUAL REPORTED CASES

Soft starter-cum energy savers for fluctuating type of loads

When a 3 phase induction motor is started at full voltage, normally it takes 5-6 times of full load current of the motor. During continuous running of motor for variable loads like pulpers, long conveyors, rechippers etc. idle run time of the motor is high thus forcing the motor to operate at a very low efficiency. Apart from intending to run the motor at as close to its full efficiency as possible, we aimed for better power factor of the equipment. By installing soft starter cum energy saver we achieved flattening of the peak load of the equipment. (Figure 2)

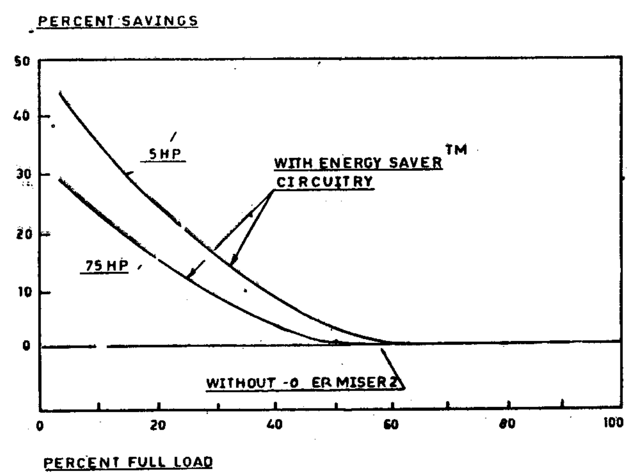


Figure 2 SAVING IN LOSSESS

Total energy saved : 3.0 Lakhs KWH/ANNUM

Power Saving by reducing the speed/trimming impellers of identified pumps and fans:

"Flow varies directly with speed wherein power varies as cube of speed." With this simple and basic concept, we surveyed for designed capacity of pumps/fans etc. and actual power required. Our survey of various equipment has given indication for scope in power saving by either reducing the rpm of fans or by trimming of pump impellers.

Total energy saved : 2.7 Lakhs KWH/ANNUM

Energy Saving by utilising full capacity of each equipment connected to common header and thus stopping at least one smallest size equipment:

i) Modification in vacuum header in Paper Machine to avoid throttling of valve.

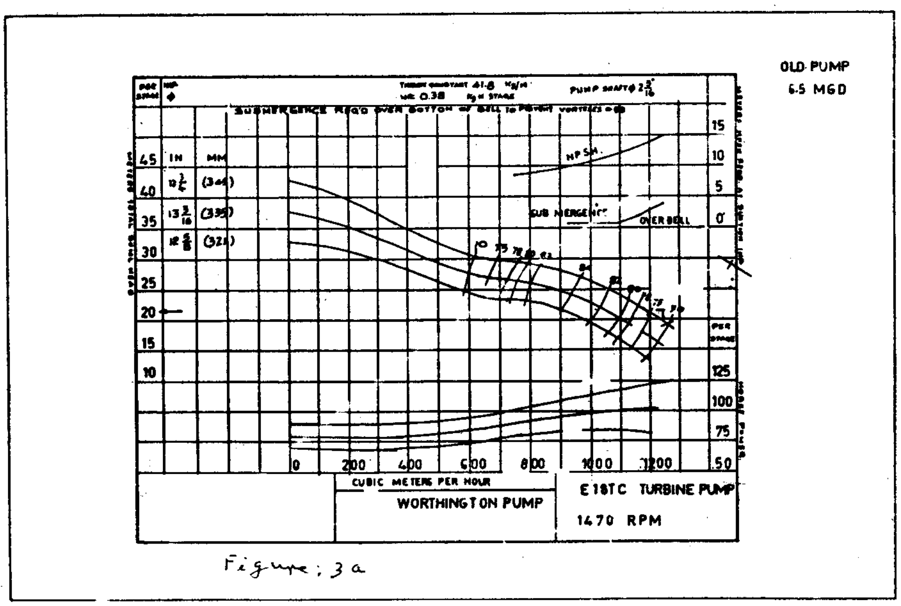
ii) Enhance the discharge capacity of warm water pump in pulp mill and thus stopping one extra pump operation.

iii) By utilising static head available at site, tertiary screen reject pump is removed.

Miscellaneous schemes implemented for energy saving:

i) Thermal insulation of MP/LP and condensate lines and tankages.

ii) Use of 36 Watts fluorascent tube in place of 40 Watt tubes.



Figure; 3a

Figure 3a

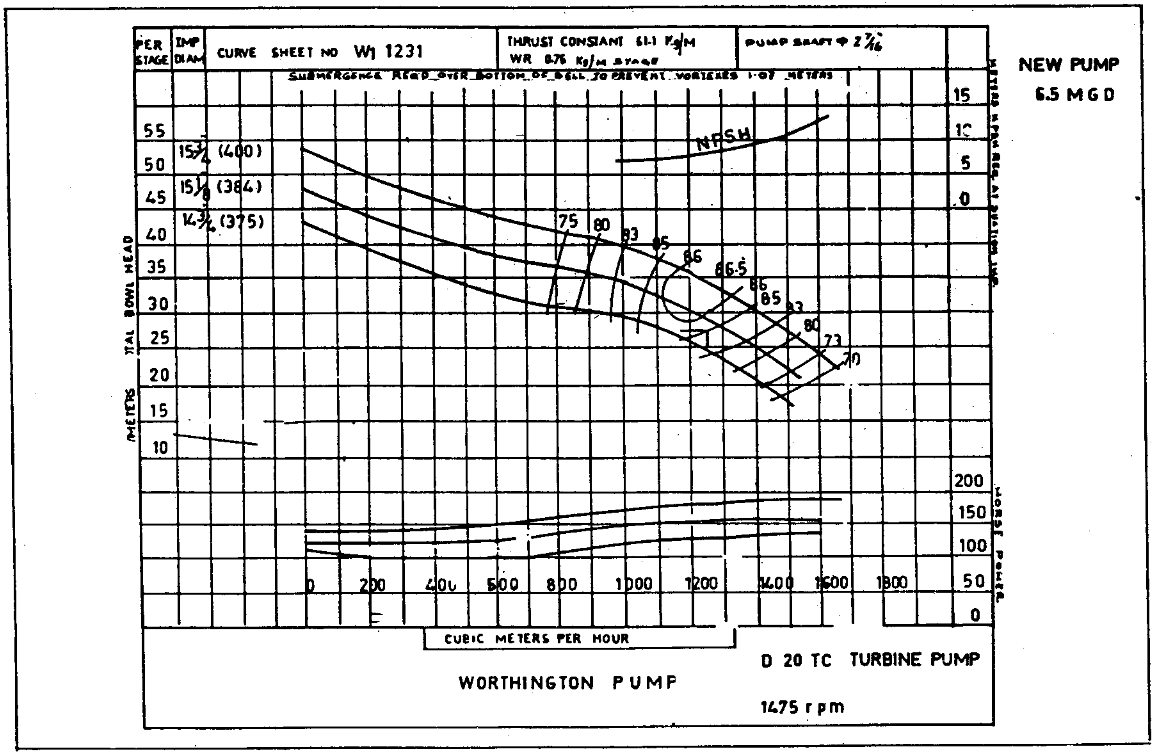


Figure 3b

iii) Installing impedance (BEBLEC MAKE) acrosslight circuit to reduce overall current in the circuit.

iv) Insulation of dryer cylinder head.

v) Replacement of over size pumps by correct size to make use of its full efficiency.

vi) To replace higher size motor by appropriate KW rating motor.

viii) Installation of temperature indicator to avoid overheating of re-causticizers.

viii) Installation of capacitors at 11 KV feeder (132/11 KV Substation).

b) MEDIUM TERM MEASURES : B - CLASS SCHEMES

Installation of high efficiency vertical pumps at River water pumping station

For pumping raw water from river bed, we had M/s. Jyothi and M/s. Worthington make old design vertical turbine pumps. The efficiency of these old pumps were hardly 60%. As the efficiency of the old pumps were very low, we invited offers from various pump manufacturer for better designed pump. The latest design vertical pumps were confirmed to be of the order of 86%. Thus by replacing four number of old 6.0 MGD pumps by new high efficiency pumps we could save considerable amount of energy. (Figure-3a & 3b).

Total energy save = 10.9 Lakhs KWH/ANNUM.

(Refer drg 3a & 3b)

Installation of DD refiners in place of Conical refiners

Conical refiners are proven to be inefficient and high power consuming equipment, as against DD refiners, for which specific power consumption could be as low as 7-9 KWH/SR^0/T of pulp, the best conical refiners couldgive 18-24 KWH/SR^0 /T of pulp.

For our biggest and latest machine we have total eliminated conical refiners. For other machines, we are in the process of replacement of all the conical refiners.

We have made extensive studies on refiner performance. Out results have shown that 45% of installed power of each refiner is basically used for its hydraulic capacity. Hence by loading refiners upto its full capacity we could avoid unnecessary running of additional refiners for achieving the same SR^0 (Figure 4a & 4b).

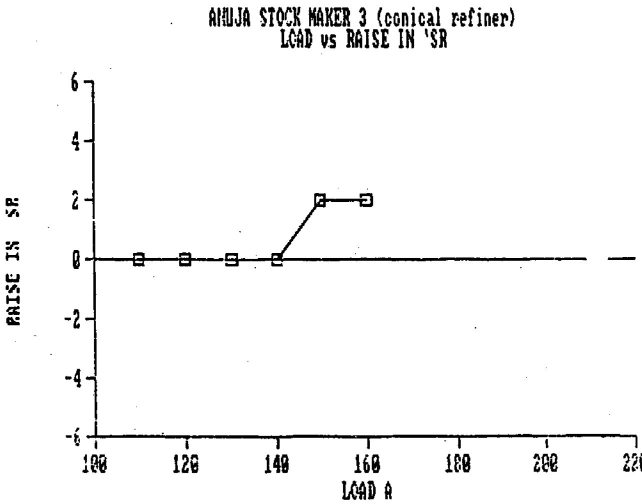


Figure 4a

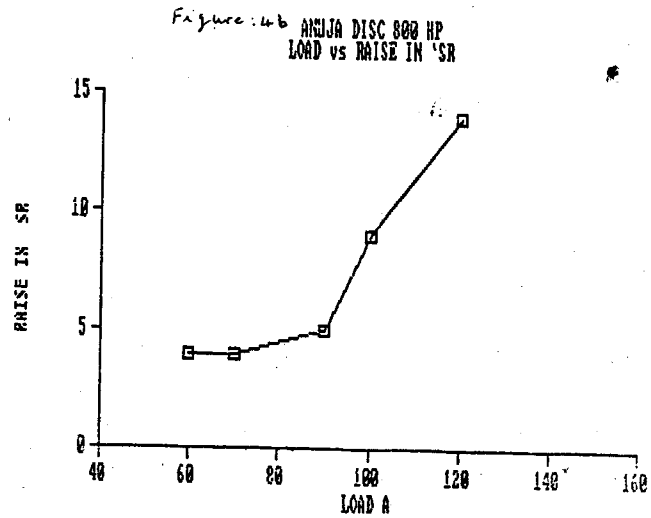


Figure 4b

Installation of DC drive in place of steam driven turbine for paper machine line shaft

Our MF paper machine had steam turbine for line shaft . The overal efficiency of single stage steam driven turbine drive for paper machine is always low. With installation of our new double extraction type turbine, we conceived the idea for processing the extra steam through new TG set and second stage extraction steam was connected to MF paper machine dryers. We replaced MF paper machine steam turbine line shaft drive by an electrical motor of 525 KW capacity. The steam consumed by line shaft turbine (5-6 T/hr) is processed through new turbo generator set to generate an additional power.

Saving = 30.62 Lakhs KWH/ ANNUM.

c) LONG TERM MEASURES : A CLASS SCHEMES

Conversion of stoker type Coal Fired boiler into fluidised bed combustion system (FBC)

Ours is a composite mill consisting of pulp, paper and recovery plants. There were 5 Coal Fired boilers of different types and capacities for steam generation. Except one new and higher steam generating capacity boiler, rest of the boilers were quite old. The four Old Boilers which were stoker type had been designed to work Boilers which were stoker type had been designed to work on high calorific value coal, (4780 K. Cal/Kg) with low ash content (25% ash).

We have experienced that if low calorific value coal with (3500 K. Cal/Kg) high ash content (40%) is fed to the boiler, the steam generation capacity of the boiler was coming down as low as 60%. Utilisation of low grade coal had also brought down the thermal efficiency from 76% to 65%.

Looking into non-availability of higher grade coal and consequent to the steam generation reduction and efficiency drop on account of low calorific value-high Sulphur content coal, we planned to modify existing stoker type boilers into Fluidised Combustion Control boiler.

To go for altogether new FBC boiler for the sake of additional steam generation was considered to be less advantageous and high capital intensive project. Accordingly we have taken up conversion of two boilers to FBC system.

By converting Old stoker type boiler we could enhance generating capacity of each boiler from 14 to 25 T/Hr. and an overall improvement in efficiency by 16%.

Total saving achieved : 6,000 T of coal per annum.

Installation of new higher capacity co-generation plant

For our mills, which has an average paper production of 265 T/day (various type & grades), the steam demand works our to be 114 T/hr. Out of the total steam consumed, only 76 T/hr. had to be utilised for co-generation. Balance steam was being used for either paper machine line shaft drive steam turbine or for the process application through pressure reducing station.

In fact due to limited capacity available in our old co-generation plant, we had to pass around 41 T/hr. (13 T/H-MP & 28 T/hr. LP steam) HP steam through pressure reducing station to meet plant demand for MP & LP steam.

Generation of steam at higher pressure and then bringing down the pressure to actual requirement through pressure reducer is shear wastage of heat energy. As there was no possibility to pass additional steam through existing turbo-generator sets, we worked out economics for new turbo generator set based on co-generation with an additional facility for condensation and paralleling the generator with

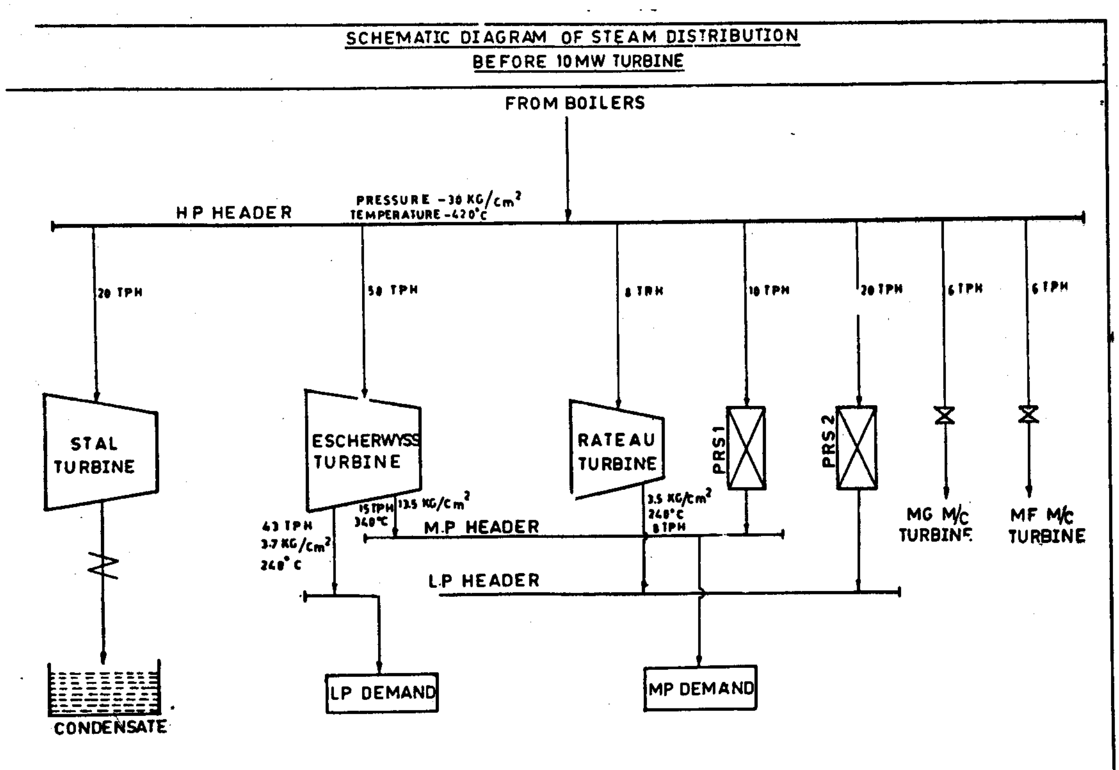


Figure 5a

state grid.

The steam and power balance thus arrived through new turbine was such that the entire amount spent on the scheme could be recovered within 6 years.

(Broad sketch showing power steam balance is given in (Figure- 5a & 5b).

Additional units generated : 253.44 Lakhs KWH/ ANNUM.

Table -1

COMPARISION OF POWER/STEAM BALANCE WITH OLD AND NEW TG SETS

		WITH OLD TURBINES			WITH NEW TURBINES
		EW TG	RAT TG	PRDS	TG GMB (10 MW)
•					
LP	T	43	8	20	70
MP	T	15	-	10	25
COND	T	-	-	-	10
TOTAL	T	58	8	30	105
POWER	MW	3.75	0.7	-	8.8
TOTAL STEAM	T	-	96		105
TOTAL POWER	MW		4.45		8.8
EXTRA POWER	MW			-	4.35*

* WITH AN ADDITIONAL STEAM FOR EXTRA POWER GENERATION

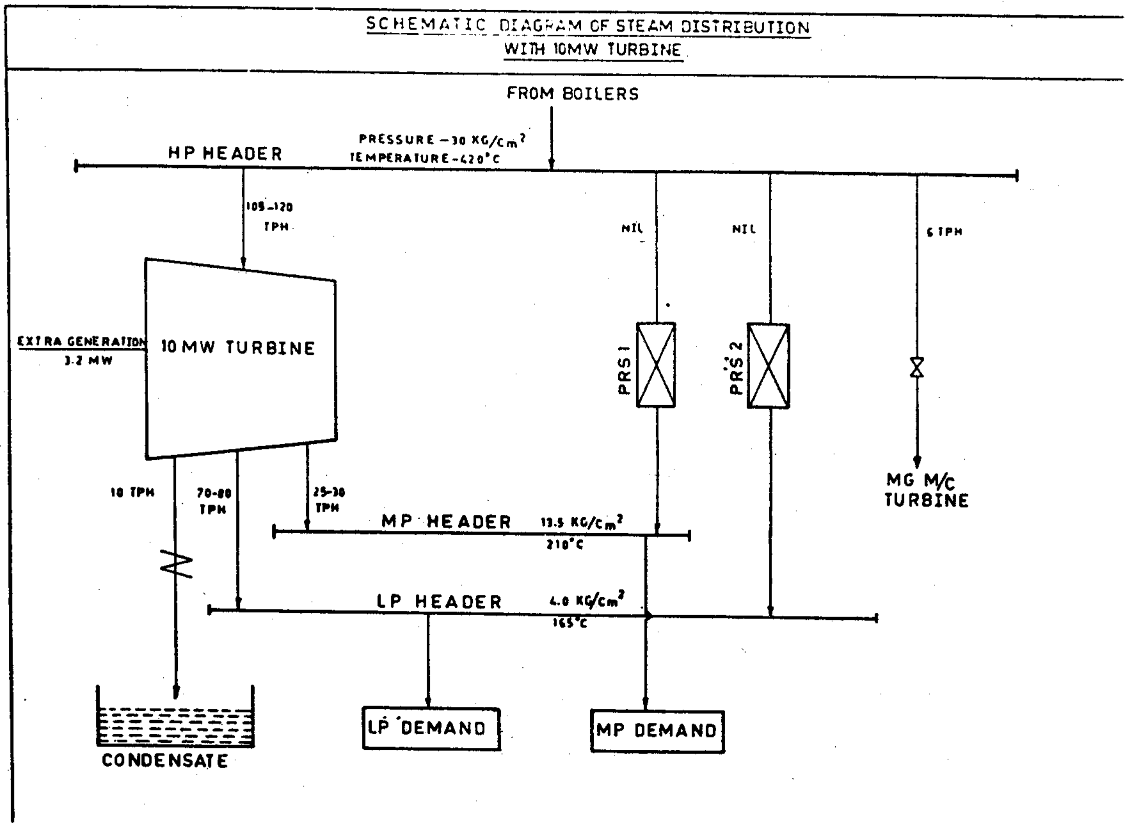


Figure 5b

C) Installation of Microprocessor based auto combustion controls for coal fired boiler to achieve higher steam generation efficiency.

Our boiler operating efficiency were calculated and found within the range of 70-75%. Since digesters and paper machine steam load is always pulsating type, pressure and temperature variation and at times steam blow off was a recurring phenomenon. With conventional instrumentation in our boilers, effective combustion control of the fuel was not possible. By installing auto combustion control by the help of Oxygen analyser in flue gases, we could improve boiler operational efficiency to the great extent. Total gain in efficiency was 1.5%.

Table 2

COMPARISION OF OPERATING PARAMETERS FOR OLD C.F. BOILERS WITH CONVERTED FLUIDISED BED COMBUSTION BOILERS

SL. NO.	TECH. PARAMETERS	CF BOILERS BEFORE CONVERSION	CF BOILERS AFTER CONVERSION
1.	MAX. CONTINUOUS RATING	18 T/HR	25 T/HR
2.	FULL LOAD RATING	20 T/HR	27 T/HR
3.	HEATING SURFACE	2029 Sq. Mtr	2092 Sq. Mtr
4.	WORKING PRESSURE	32 Kg/Sq.Cm	32 KG/Sq.Cm
5.	TYPE OF GRATE	CHAIN GRATE	FBC
6	GRATE AREA	28.2 Sq.M	27.0 Sq.M.
7.	BOILER EFFICIENCY	65%	78%

Conclusion

Like any other industry, there are continuous efforts to improve the quality of paper and paper making equipment. Due to continuous endeavour to improve the efficiency of equipment and to make machineries more productive and economical, APP Mills realised the necessity of continuous and consistent efforts to be put in by Plant Engineers for conservation of energy. In Andhra Pradesh Paper Mills energy conservation is not merely a drive by the Management but a movement by Operting Engineers in the whole mill.