

## Co-Generation at J.K Sugar, Mirganj, Bareilly – A Case Study

### Introduction

J.K. Sugar, a member of the large industrial house J. K. Organisation, is situated at Mirganj, district Bareilly. Presently the plant crushing capacity is 4500 TCD. We have 2 Nos. Turbo-Alternator of 19.10 MW/Hr. capacity and we are exporting 10 MW power to the UPPCL grid.

The factory was commissioned in the year 1995-96 with a crushing capacity of 3500 TCD. Right its installation the power was planned. Accordingly, Boiler & Turbo-alternator was installed. The detail of Boiler & Turbo-alternator set is given below.

### Boiler – 1

Capacity	-	80 TPH
Pressure	-	45 Kg/ Cm <sup>2</sup>
Temperature	-	480° C ± 5° C

Main bank type, moving grate WIL make

### Details of Turbo-Alternator

#### T.G.-1

Type	-	Back Pressure
Capacity	-	9.10 MW / Hr
Make	-	Siemens
Voltage	-	6.6 KV
Inlet Steam Pressure	-	42 Kg. / Cm <sup>2</sup>
Steam Temperature	-	480° C ± 5° C

Accordingly all the big motors of Leveller, I.D. Fans, Feed pumps, Injection pump motor were installed 6.6 KV. To reduce steam consumption quintripple effect evaporator was installed with exhaust pressure of 1.10 Kg./ Cm<sup>2</sup>

### Inception of Co-Generation at J. K. Sugar

On 16<sup>th</sup> July, 1996 the PPA was signed with UPSEB for the export of 4 MW power. To follow immediately after 33 KV Sub-Station installation work started and line (33 KV) was laid to Mirganj Sub-Station installation work started and line (33 KV) was laid to Mirganj Sub-Station, which is 3 KM away from factory. In April, 1997 trial of power export was carried out. We synchronized the turbine with grid by providing 7.5 MVA transformer on 33/6.6 KV and bringing 6.6 KV supply to power house and matching the grid voltage and frequency with our 9.1 MW Turbo-alternator frequency and 6.6 KV voltage.

During the trail run, we had exported 26000 KWH power in the first year and from the season 1997-98 the power export being carried out with the beginning of the season.

During the season 2000-01 crushing capacity of factory expanded to 4500 TCD and a Boiler and condensing cum extraction mode Turbo-alternator was installed the details of which is given below:-

### Boiler – 2

Capacity	-	55 TPH
Pressure	-	36 Kg. / Cm <sup>2</sup>
Temperature	-	464° C ± 5° C

Moving gate WIL make Battle Type Boiler

## T. G. 2

Type	- Double extraction cum condensing
Make	- Broven Boveri
Capacity	- 10 MW / Hr.

### Steam consumption

a) L.P. Extraction – 2.5 Kg. /Cm <sup>2</sup>	- 9 Kg. / Kwh
b) H.P Extraction – 9 Kg. / Cm <sup>2</sup>	- 15 Kg. / Kwh
c) Condensing	- 4.80 Kg. /Kwh

Transformer of 7.5 MVA was installed from 6.6 KV to 11 KV & new Sub-Station of 132 KV installed in the premises with 15 MVA transformer from 11 KV to 132 KV.

Power export of 6.5 MW started after signing of new PPA of 6.5 MW with UPPCL. Since we have been generating power, to meet our process steam with extraction mode of Turbine no. 2, new PPA has been signed with UPPCL to export 12.50 MW of power. For export of so much of power as per the rule was laid down upto C.B. Ganj which is 25 KM from the factory and new Sub-Station in the factory was installed for 132 KV line. Transformer of 15 MVA, 11 / 132 KV was installed. Photo of our Sub-Station is enclosed herewith.

For our crush rate of 4500 TCD our steam consumption of process steam requirement is 50% on cane. Accordingly the extraction of steam from TG-2 is being operated.

### Process Control Parameters

For efficient and smooth working of power plant, following controls and monitoring is needed on the regular basis.

1. Quality of Boiler water – The quality of Boiler water must be maintained as per standard parameters i.e. hardness nil, TDS 10 ppm to 20 ppm, pH – 9.2 to 9.4 M-Alkalinity 7 ppm to 15 ppm, P-Alkalinity 5 ppm to 10 ppm, Silica Max. 2 ppm.

For maintaining the quality of water only exhaust condensate to be used in the Boiler, and approx. 20% to 30% D.M. water is being used, on regular basis in the Boiler. We are using poly-amine base single chemical for Boiler water treatment and since last 4 years, no cleaning of Boiler tubes is being done.

2. Regular monitoring of parameters
  - a) Steam consumption
  - b) Power consumption
  - c) Bagasse consumption

For the monitoring of above parameters a format is designed to indicate all the parameters.

For ensuring regular & consistent performance, standard deviation technique has also been used.

3. Quality of cooling water – It is most important that quality of cooling water is being maintained as per parameters pH 8.4, TDS 200 to 300 ppm, COS-6.

In the cooling tower 60% soft water is being used as make-up water. The excess condensate water is also being as make-up water.

1. On line cleaning of Radiators – Due to continuous operation of TG-set we have installed the system of on line chemical cleaning arrangement for Radiators of TG-Set.

## Calculation on Data Base

We are giving below the calculation of the generation of power plant and power export of 10 MW to the grid on the basis of process steam requirement.

Crush Rat	- 4500 MT
Hourly Crushing	- 188 MT
Bagasse generation (31.5% of cane)	- 59.22 MT
Steam generated ratio	- 2:1
Capacity of Boiler No. 1	- 80 MT
Capacity of Boiler No. 2	- 60 MT
Workable capacity of TG-1	- 8/50 MW
Workable capacity of TG-2	- 9.00 MW
Steam requirement of T.G No. 1	- 7.25 MT/MW
Steam requirement of L.P. Extraction mode.	- 9 MT/MW
Steam requirement of condensing mode	- 4.80 MT/MW
Total internal consumption	- 6.40 MW/Hr.
Total steam required 50% on cane	- 94 MT
Boiler No. 1 (Loading)	- 62 MT (Power Turbine No. 1)
	- 11 MT (Fibrizer Turbine)
	- 3 MT (Process through PRDS)
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	76 MT/Hr.
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Boiler No. 2 (Loading)	- 26.50 MT (Condensing mode)
	- 20.00 MT (Extraction mode)

## Generation, consumption & export

Generation from TG- 1	- 8.50 MW
Extraction mode from TG- 2 (20 MT)	- 2.20 MW
Condensing mode from TG- 2 (26.5 MT)	- 5.50 MW
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Generation TG- 1 + TG- 2	- 16.20 MW
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Power available for export	- 16.20 – 6.40 (Plant consumption)
	= 9.80 MW / Hr.
Day power export (Average)	- 23 Hrs. x 9.80 MW
	= 225400 KWH

For a co-generation plant Boiler water treatment plant is of paramount importance.

## Details of D. M. Plant & Softening Plant

2. Nos. D. M. Water for Boiler	- Ion Exchange – 20 m <sup>3</sup> / hr.
	- Thermax – 30 m <sup>3</sup> / Hr.
2. Nos. water softening, plant capacity	- 50 m <sup>3</sup> / Hr.
	- 20 m <sup>3</sup> / Hr.

## Details of condensor

Capacity	- 31 Ton / Hr.
Type	- Tubular, Brass Tube
Tube Size	- 24 mm dia x 5000 mm Long
No. of Tubes	- 2460

## Detail Cooling Tower

No. of Unit	- 2 Shells
Capacity	- 2250 m <sup>3</sup> / Hr.

Make	- Paharpur Cooling Tower
Reduction Temp.	- 9° C to 10° C
Make	- Paharpur Cooling Tower
Circulating cooling water pump	- 3 Nos.
Capacity	- 1050 m <sup>3</sup> / Hr.
Head	- 22 Mtr.
Motor	- 150 HP, 1440 RPM
For vacuum system	- Water jet ejector

### **Generation & Power Export During Different Season**

The data on generation and power export during different crushing seasons is shown in the enclosed graph. It may be seen from the graph that generation and power export increased from 116.96 Lac. KWH to 313.87 Lac. KWH upto 11.03.2003 and 60.19 Lac. KWH to 167.39 Lac KWH upto 11.03.2003 respectively.

During the season 2002-03 till 11<sup>th</sup> March 313.87 Lac. KWH has been generated out of which 167.39 Lac. KWH has been exported. At present, power is being exported @ 2.10 to 2.5 Lac. KWH per day.

### **Co-Generation upgradation from 33 KV to 132 KV**

#### **Highlights**

Experience in upgradation of voltage level from 33 KV to 132 KV in interfacing with grid of UPPCL.

1. Power export at higher voltage i.e at 132 KV will be always beneficial in most of the cases as -
  - a) Contribution in new line erection will be 50% of UPPCL in case of 132 KV, which will be nil in case of 33 KV.
  - b) Lower level of current (i.e. one fourth in 132 KV than 33) will cause less maintenance of current carrying and making / breaking equipments.
  - c) Due to grid over loading, most of the grid Sub-Station transformers of ratio 132/33 KV are set its maximum Tap of OLTC, which results in higher voltage in roistering hours as well as in bad weather situations when grid becomes under load but this situation does not comes with OLTC of 132 KV system and we are supplying power in all conditions at full swing.
  - d) Chances of conductor theft in 132 KV are nil in comparison to 33 KV in present scenario of our society.
  - e) Reliability of grid line is much more in 132 KV in comparison to 33 KV in terms of routine maintenance is required more in 33 KV & 33 KV Sub-Stations required more shut downs.
  - f) Capacity enhancement may be done upto 50 MW in single circuit of 132 KV transmission line/system but mwe can go upto only 10 MW in case of 33 KV.
  - g) Power fed on 132 KV will be in much more grip of UPPCL for its better utilization as per this requirement of realization, so increased rates of power may be set by UPPCL in comparison to 33 KV in near future.
  - h) Trippings in power export due to voltage fluctuations were more in case of 33 KV than 132 KV.
  - i) Due to change of voltage level, it will be changed automatically the control/nodal officer of UPPCL. In case of 33 KV, it will be governed your power export by distribution wing of UPPCL and in 132 KV, it will be controlled by transmission wing of UPPCL which is more understandable then existing because those are not directly involved in public dealing.
  - j) Line erection is easier in case of 132 KV line because pole to pole distance is 4 times than 33 KV i.e. we have to face one fourth land holders for pole installation in 132 KV line.
  - k) On / Off operations during roistering hours are done in 33 KV, so the voltage fluctuation due to this reason gives tripping atleast twice daily in 33 KV system.
  - l) Line losses in 132 KV line are one fifth of the 33 KV transmission line, which is a huge saving in 132 KV system.
  - m) Power Purchase Agreements between UPPCL and firms have been furnished with tough conditions in case of 33 KV.

- n) 132 KV system will make available continuous banked power off-season consumption and D. G. operation will be avoided which is costly affair for off-season in sugar mills.

### **Disadvantages**

1. Line maintenance is easy in case of 33 KV than 132 KV transmission line.
2. Spare parts of 33 KV line / Sub-Station are less costly and easily available during the season.
3. We had to put another tripping programme in PLC software at 132 KV system due to grid instability, which is common in UPPCL grid, it was not required in 33 KV, because Sub-Station staff itself cuts 33 KV feeders during grid instability.
4. 132 KV system will cost much higher (three to four times) than 33 KV.

### **Acknowledgement**

The co-generation at J. K. Sugar since beginning of the plant has been a grand success and key driver of the plant only because of consistent working, motivation encouragement financial and technical support from Dy. M.D., Shri V.P. Singhania and President (Sugar), Shri O. N. Rai for which we are extremely thankful to them.

### **Reference book:**

All India Seminar on "Ethanol & Co-Generation"  
30<sup>th</sup> March 2003  
At Nanital, Uttaranchal