GENERATING POWER THROUGH MAINTENANCE STOP DAYS

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Abstract

Umzimkulu Mill is able to reduce its energy costs by generating mill electrical power during schedule weekly maintenance stop days. Excess bagasse is utilized to fuel the boilers thus providing steam to drive the turbo-alternators and produce electrical power. This electrical power was previously supplied by the Electricity Supply Commission (ESCOM).

Introduction

Umzimkulu Mill has traditionally switched into ESCOM power during its weekly 20 hour maintenance period. However, the mill had the capacity to generate large quantities of bagasse in excess of the amount required to fuel the boilers and this had, at times, resulted in a disposal problem. As a result of this it was decided to undertake a feasibility study into utilizing the excess bagasse to generate power during the stop days. This study led to the implementation of the necessary plant modifications to facilitate the required power generation.

Procedures previously used for excess bagasse disposal

- Operating the boilers inefficiently which resulted in the burning of greater quantities of bagasse than was normally required to fuel the boilers.
- Adding additional quantities of imbibition water to the milling train which had the advantage of improving extraction.
- Dumping of bagasse which entailed transporting the bagasse in tractor/trailer units to one of two dump sites situated approximately 2 km from the mill.

Costs involved in disposing of excess bagasse

Annual operating costs (Oil, fuel, tyres and maintenance)	= R 8 500,00
Labour - Four Tractor Drivers (Excluding overtime)	= R 28 464,00
12,5 % Depreciation on cost of tractors and trailers	= R 12 500,00
Total annual costs	= R 49 464,00
Cost per month	= R 4 122,00

Cost of Escom Power during 1986

The average monthly cost of ESCOM power consumed during the crushing season was R14 762. This was for a maximum demand of 995 kVA and an energy consumption of 49 000 kWh/month. An extension charge of R1 000 was also included irrespective of whether the mill consumed power or not.

Estimated electrical load and fuel requirements when generating mill power

On a stop day at 14h00 the electrical consumption of the mill complex, whilst generating its own power and supplying one of the company's housing estates, was 1 200 kW. During the period 01h00 to 15h00 the base load was taken to be 1 600 kW (figure 1). This proved to be conservative as the load was substantially less between 01h00 and 07h00 when no maintenance work was being undertaken and domestic demand was low.

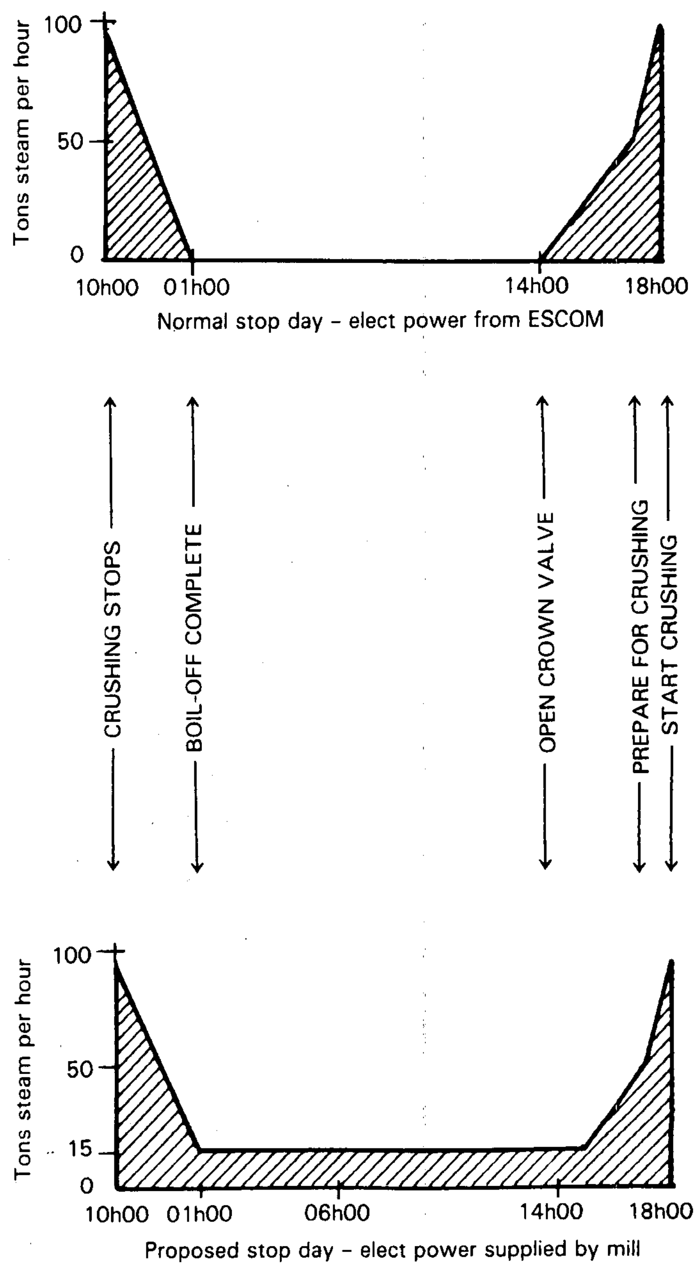

FIGURE 1 Typical steam demand patterns.

At a turbo-alternator steam rate of 9 kg per kWh generated, quantity of steam required to generate 1 600 kW for 14 hours (period 01h00 to 15h00) was $1\,600 \times 9 \times 14 \times 10^{-3} = 201$ tons. Fuel (bagasse) required to generate this steam was calculated as follows, assuming that 1,7 tons steam was produced per ton of bagasse burnt:-

$$\text{Total fuel required} = \frac{\text{Total tons steam}}{1{,}7} = \frac{201}{1{,}7} = 118 \text{ tons}$$

In practice due to low system efficiency it required double the calculated quantities of steam and fuel to generate the required power ie 402 tons steam and 236 tons fuel.

At a fibre throughput of 32,5 tons per hour the mill produced an excess of approximately 380 tons of bagasse per week which was sufficient for boil-off, start-up and generating through the stop day.

Cost of generating mill power during a stop day

In a month with five stop days the cost of the mill generating its own power was as follows:-

ESCOM extension charge	= R 1 000
Overtime costs for operational staff	
- Engineering	= R 650
- Process	= R 625
Total	= R 2 275

Savings using mill power

Average cost of electricity during 1986	= R 14 762
Excess bagasse disposal cost	= R 4 122
Total	= R 18 884
Less cost of generating mill power	= R 2 275
∴ Total savings per month	= R 16 549

Once the system had been commissioned it was possible to realise a saving of R16 549 per month if no switch into ESCOM was made and no supplementary fuel (coal) was consumed. On occasions however, due to long stops normally caused by a lack of cane supply, coal had to be burnt to supplement the bagasse supply. It was necessary therefore, to calculate the break-even point for either burning coal or switching into ESCOM supply.

The following formula was used for calculated the break-even period:-

Cost of maximum demand + (cost of energy consumption per hour × number of hours) = cost of coal required per hour + overtime costs per hour for operating staff.

This break-even period worked out at approximately 40 hours for Umzimkulu Mill, ie if the mill has to burn coal for a period longer than 40 hours in one month then it would be more economical to switch into ESCOM power.

It was possible to offset coal consumption by storing additional bagasse outside the existing bagasse shed. Approximately 120 tons could be stored in this manner. A proposed extension to the bagasse shed is being investigated. A minimum power consumption start-up procedure for the boiler station was implemented which limited the maximum demand to 350 kVA when starting up on ESCOM power. This prevented a high cost being incurred in the event of an unplanned switch into ESCOM power.

Capital requirements for valves and modifications to piping

To regain condensate, it was necessary for the mill to condense exhaust steam in either one of the first effect evaporators during a stop day. To facilitate this the V1 steam range and mixed juice pipelines were sectionalised. A double valve and bleed system was installed on the V1 steam line to ensure the safety of personnel cleaning the other first effect evaporator.

The total cost for new valves, piping and installation labour was R18 500.

Conclusion

The system was commissioned in July 1986 and thereafter the mill successfully generated through stop days for four months without switching into ESCOM power. This resulted in a saving of R50 000 in electricity costs alone. It is planned to generate through seven months of the crushing season in 1987 without switching into ESCOM.

As a result of the success of the above system a feasibility study was undertaken which has shown that it will be economical to supply another of the mill's housing estates with mill rather than ESCOM power as is done at present. This will be done in 1987 and should realise a further saving of R5 500 per month in electricity costs.

The availability of steam during a stop day has also brought the possibility of chemical cleaning of the evaporators into consideration and in this regard a feasibility study is currently being undertaken.