IN HOUSE POWER CONSERVATION THROUGH PRUDENTIAL METHODS

BY

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ABSTRACT

Sugar Mills are not only fulfilling their needs of Energy, but also having a capacity to generate more Power from their needs and Export surplus power to National Grid. Power distributor companies are already facing short fall of power and ready to purchase power from Sugar Industries without any limitation. This paper explained the prudential methods of Power conservations because **THE MORE YOU SAVE THE MORE YOU SELL**

INTRODUCTION

Sugar Mill in present shape does not seems to be a feasible proposition because of high cost of raw material and production cost. Therefore the Industry is now adopting different measures with regard to utilization of by product. Bagasse being one of the most important by product is being concentrated upon on priority and Sugar industry is adopting different measures to indulge into cogeneration and surplus power generation for supply to the National Grid, which

is facing shortage of Electricity and the demand, is increasing day by day. There are different stages to achieve this goal economically .The most important is in house power conservations .In order to achieve efficient in house working results and achieve maximum saving of energy .

INTRODUCTION

The following measures recommended to be adopted;

1. **INSTALLATIONS OF INVERTORS AT DIFFERENT APPLICATIONS**
2. **REPLACEMENTS OF OLD AND REWOUND MOTORS WITH HIGH EFFICIENCY MOTORS**
3. **RIGHT SIZING OF MOTORS , PUMPS AND OTHER EQUIPMENTS**
4. **SETTINGS OF IDEAL PARAMETERS**
5. **OPERATIONS OF EQUIPMENTS AGAINST REAL NEEDS AND VOLUMES**
6. **IN HOUSE CONTROL ON UN-NECESSARY WASTAGES**
7. **AUTOMATIONS**
8. **TRY MISTAKE FREE OPERATION**
9. **PROPER HOUSE KEEPING**

1 - INSTALLATION OF INVERTERS AT DIFFERENT APPLICATIONS

VFDs are recent entry in Sugar Industries, it is no doubt that VFDs are costly, one time capital cost is required, in some cases vfd saves switch gears and cables expenses. But VFDS provide following large operational power conservations

A. **Power Conservations against the Variation of speed**
B. **Reduction of initial high torque**
C. **Power Conservations at Normal speed**

A - POWER CONSERVATIONS AGAINST THE VARIATIONS OF SPEED

Inverters provided three kinds of Power observations as;

i. Inverters reduced the expenditure of V.S. trains at desired frequency

ii. Inverters reduced the transmission losses

iii. Inverters provided large power conservations at low and desirable RPMs

B- REDUCTION OF INITIAL TORQUE

Starting torque is major reason of accident, failure of equipments, damage of power source and prime movers .VFD minimized this headache and initially raised rpm of Motors from Zero level and without high power damage.

C- POWER CONSERVATIONS AT NORMAL SPEED

When electric motor is operated on load at that time two loads are exercised;

i) Mechanical load

ii) Electrical load

MECHANICAL LOAD

This load relate with real burden, mechanical load is only reduced with the reduction of burden therefore at normal speed it is very difficult for VFD to reduce mechanical load without removal of real load

ELECTRICAL LOAD

Electrical load on motor is 25% to 40%. This electric load can be reduced 15% to 25% by installing VFD and over this entire reduced load will be the sum of 10% to 15% of total load.

MILL HOUSE

Large Power conservation noted at Mill House. One calculation of power conservation of one 6000TCD Mill is as following;

Mill #	Mill RPM	RPM of Turbine (If fitted)	Steam calculated at 15 Kg/KW	RPM of Motor with VFD (if fitted)	Power noted in KW	Steam calculated at Power House	Diff:	Remarks
01	2.74	480	8.7	480	325	3.25	5.45	Motor Fitted
02	5.2	1050	6.14	900	410	4.1	2.04	Turbine fitted
03	3.9	800	8.69	682	313	3.13	5.56	Turbine fitted
04	3.9	900	7.65	770	449	4.49	3.16	Turbine fitted
05	4.4	950	9.2	850	543	5.4	3.8	Turbine Fitted
TOAL			**40.38**			**20.37**	**20.01**	

MILL HOUSE

If this 20 tons saved steam is converted into power, its pay back is as following

20 x 1000/10 = 2MWH

2000 x 24 x 10 x 120 = 57.6 Millions

Quoted price of 4 sets with gears are100 Millions

Pay back of system is 172 Crushing days

Its pay back is 1.5 (172 Days) Season approximately

If this saved 20TPH steam converted into bagasse then

(20/2) x24=240 tons/day

BOILER HOUSE

- Boiler House has also a large potential of power conservation through VFDs at IDs,FDs, Secondary's and Feeders electric Motors . It is noted that at some places staff thinking of speed controls against the VS drives and Heenan drives or Vent control in place of Dumpers, it is correct but VFDs provided main advantage of power conservation, especially with automation, in some cases operators use some loops at manual mode and other on auto mode. Perhaps physically this practice does not give any problem but electrically it is not feasible because if any one loops changes into manual mode, then electrical Motors will run un-sequentially.

BOILER HOUSE

- Experience showed that Inverters also provided more power conservations at pumps. Mostly Feed pumps of Boilers are high speed and Feed pump gives same head pressure of 2960 rpm at 2800 rpm, apparently there is only difference of 160 rpm but electrically Motor reduced its 20% load.
- One ton bagasse can be saved on daily basis at Feed pumps by Installing VFDs.

PROCESS HOUSE

Potential of power conservation through VFDs are available in process house large power conservation can be achieved at Injections, Spray pumps and Cooling Tower Motors.

One 8000 TCD sugar Mill consuming 1MWH power at Injections, spray pumps or cooling Towers , If running Motors to be connected through VFDs then Power conservations of 200 KWH can be achieved which is equal to 24 Tons of bagasse on daily basis.

2- REPLACEMENTS OF INEFFICIENT MOTORS

We normally like1st time cheapest Motors and ignore the consumption of Electricity and efficiency of Motors.

Experience showed that Rewound Motor becomes de-rated and take 5% more current. Reoccurrence of faults in rewound Motor is more than in original motors.

2- REPLACEMENTS OF INEFFICIENT MOTORS

Descriptions	High efficiency Motor	Standard efficiency Motor	Rewound Motor	Used Motor	Over Rating Motor
Rating of Motor	11 KW	11 KW	11KW	11 KW	15KW
Load at same application	9.0 KW	9.3 KW	10.3KW	Nil	11.81 KW
One Season (120 days) Consumption	25.92 MWH	26.78 MWH	29.66 MWH	Nil	34.0 MW
According to NEPRA approved tariff for Sugar Industries	Rs:259,200/= Without GST	Rs:267,800/= Without GST	Rs:296,600/= Without GST	Nil	Rs.340,000/= Without GST
Difference		Rs.8,600/=	Rs.37,400/=	Nil	Rs.80,800/=
Pay back		1.5 season	2 seasons		One Season

USED MOTORS

Motors are always designed against the applications .used Motors are discarded, rewound or un-matched with proposed applications. Provides insufficient duty, create problems at the time of high need, repairing cost is more and comparatively consumed more power.

STANDARD MOTORS.

Motors manufacturers have stopped manufacturing standard Motors and gone to high efficiency high efficiency Motors, but stock of standard Motors are available in Pakistan, further purchase of these Motors are not feasible, for the industries.

2- REPLACEMENTS OF INEFFICIENT MOTORS

OVER RATING MOTORS

Sometimes over size Motors are installed and accurate size and solutions of tripping is claimed in place of new Motor and apparently smooth operation is observed but this is slow wastage of electricity comes certain damages.

2- REPLACEMENTS OF INEFFICIENT MOTORS

Following table show the operational cost difference of above Motors.

BUDGETARY/QUOTED price of High efficiency Motor is about **Rs.85, 000/=**

3 - RIGHT SIZING OF ELECTRIC MOTORS AND DRIVEN APPLICATIONS

Some people increase the size of equipments as per their need without any calculation or change equipments according to Historical data, but these are only guess values. Calculations must be made on actual parameters, efficiency of equipments and decline conditions of existing equipments. In order to increase the power equipments following points must be kept in views

a) Power/Energy increase is inversely proportional to the working efficiency .

b) Power Increase formula should as under;

Increase in the size of equipments = Increase in through put x Designed Power % age

a) Right sizing of Electric Motors and other equipments to be done at its needful places and addition of discarded equipments to be discouraged

4 - SETTING OF IDEAL PARAMETERS

Remarkable Power conservation can be achieved with setting of Ideal Parameters;

Following table illustrates the benefits and standard of parameters

Sr.#	Parameters	Ideal Values	Remarks
1	Power factor	0.9 to 0.95	Unbalance and poor Power factor is the killer of power conservation.
2	Line Voltages	400/220	If line voltages accessed tolerance ratio of 2.5% than current of Motor could be unbalanced.
3	Temperature of Electric Motors	Less than 60 C0	Yes it is right that Motor can survive at high temperature but consume more power.
4	Temperature of Cables and Switch Gears	Equal to Room Temperature	High temperature is the indication of undesirable flow of any parameter and resulting in high power consumption.
5	Friction Less Movement of Mechanical device		More friction More BHP.
6	Proper alignment of Electric Motor with Mechanical device	Must be in straight line (o-degree angle)	
7	Vibration	Less than 1 mm/s	

4 - SETTING OF IDEAL PARAMETERS

By achieving above parameters we can save more than **5%** power conservations at running load.

This 5% running load will be equal to 7600 KWH per day and this will be equal to 38 Tons of bagasse per day

5- OPERATION OF EQUIPMENTS AGAINST REAL LOAD

Avoid the unnecessary operation of electric Motors for easiness; try to operate equipments at their rated capacity and as per requirement of plant. For example 3 Nos. electric Motors of 75 KW at continuous centrifugal station are operated normally we can achieve same results by operating two Motors Efficiently

- Operator operate all three Motors at 90 A load meaning 56 KW, total load of 3 Motors is 168 KW
- Mechanical load of each Motor is 36KW and Total Mechanical Load is 108 KW
- Electric Load of 3 Motor is 60 KW
- The same can be achieved with the operation of two motors at aload of 137 A against rated 140 A of Motor
- With the operations of two Motors 20 KWH power conservations can be achieved
- This 20 KW is equal to 2.4 tons bagaase per day saving.

6- UNNECESSARY WASTAGES OF POWER

It is noted that in routine operations we can get power conservations by discouraging wastages of power by controlling the following loses;

1) Discourage the parallel operations of stand by equipments due to any reason.
2) Notations of daily running load of Electric Motors above 30 HP to be attended immediately.

3) To check the load of all out going Feeders on hourly basis increase of Power consumption to be noted.

4) To stop extra wastages of water.

5) Unnecessary lightings should be put off at day times.

7 – AUTOMATIONS

Automations not only provide easiness in operation, but also give sufficient power conservations especially at Boilers. Mill House, Injections, Spray and Cooling Towers etc. Partial operation of automation cause inefficient operation.

8 - TO TRY MISTAKE FREE OPERATION

Proper operation of equipments always minimized the chances of accidents. Accidents never come without invitations; it is always there and occurs at the time of mistakes. Therefore it is necessary that mistake free operation should be tried. If any accident occurs the remedial actions must be ready. Because accident not only disturb the operation of Mill but also cut of conservation ratio, which is achieved in prudential operation. For example one hour's accidental stoppage of 8000 TCD Mill disturb the achieved power conservations of 23 Hours.

Achieved Power% cane of 23 Hrs	Power wastages during stoppage (1 Hour)	Over all Power % cane of 24 Hrs	Amount of wasted Power	Remarks
75.60	5000 MWH	78.21	Rs.50,000/=	This amount is calculated against only Power

9 - PROPER HOUSE KEEPING

Proper Housekeeping is essential for good results and Power conservations. In view of power conservations all apparatus must be remain in working

order according to ideal parameters. Some basic requirements for proper housekeeping are as followings;

- **All switch gears ,Inverters, PLC and DCS should be intact with given parameters**
- **All Generators, Motors must be clean, protected from external accumulations and should be working at ambient temperature and proportional to the ratings**
- **All Pumps, gears and other applications must be sound free and no leakage of Raw material**
- **Floor must be cleaned from dust and oils**

9 - PROPER HOUSE KEEPING

By adopting the above measures at least fuel of 305.4 tons of bagasse can be saved and surplus power of this bagasse can be exported to the National Grids, as the Govt is encouraging Cogeneration and offering attractive tariff to Sugar Mills for supply of surplus power electricity.

Since the quantity of the surplus power in most of the cases is not within the limit of minimum power purchase parameter. Therefore following measures can be adopted to enhance to power by adding certain equipments and utilizing existing equipments efficiently.

HIGH PRESSURE BOILERS AND TURBO ALTERNATOR SETS

Existing low pressure Steam Generators (Boilers) of 24 bar and 327 C^ and Turbo sets of same parameters are not feasible especially for cogenerations purpose, High pressure boilers are generating high pressure steam almost at same ratio of fuels. But high pressure Turbines is more efficient and consuming only 4kg/KWH steam. With H.T sets you will generate 2.5 times more power from the existing low pressure sets, following table illustrate the difference of HP and LP sets.

LOW PRESSURE SETS POWER GENERATION FROM 1 TON OF BAGASSE			HIGH PRESSURE SETS POWER GENERATION FROM 1 TON OF BAGASSE			Difference of Earning
Steam Generated in kgs	Power generated at 10kg/KWH	Earning according to WAPDA tariff	Steam Generated in Kgs	Power generated at 4kg/KWH	Earning according to WAPDA tariff	
2000	200 KWH	Rs.2,000/=	2,000	500 KWH	Rs.5,000/=	Rs.3,000/=

Approximately pay back of HP sets

Crushing in tons	8000
Bagasse at 30% ratio	2400
Steam generated in tons (TPH)	174
Exhausted steam required at 52% ratio for process requirements	174
Steam required for low pressure accessories	54 tons
Total Power generated from 140TPH	31.25MWH
Self requirement at 0.76 KWH/mons or 19 KWH/tons	8 MW H
Balance power exported to WAPDA	23.25 MWH
Earning of 120 days during season	Rs.669.4 millions
Pay back	Given Below

HIGH PRESSURE BOILERS AND TURBO ALTERNATOR SETS

1) Bagasse generated 2400 TPD – Bagasse Consumed 2088 TPD.
2) Balance Bagasse saved in 120 day of crushing season = 37440 Tons.
3) Bagasse saved by prudential methods as discussed above 305.4TPD=36648 Tons for 120 days of season (If any problem of exhausted steam accrued then this quantity of bagasse can be consumed for power generation during season).
4) Total saved Bagasse 74088 tons of bagasse.
5) From this saved bagasse two month power House can be operated and following table define the parameters and Revenue.

Available Bagasse in tons	74088
Bagasse require for next season n tons	10000
Balance Bagasse in tons for Power export	64088
Steam generated in tons (TPH)	125
Total Power generated from 140 TPH	31.4 MWH
Utilities Requirements	2 MW H
Balance power exported to WAPDA	29.4 MWH
Earning of 43days	Rs. 303 .4 millions
Pay back	Given Below

1) Expenditure of HP set of 140 TPH Boiler and 40 MW Power House approximately Rs.1,000 Millions
2) Expenditure of Mill House VFDs, Electric Motors and Gears Rs.100 Millions
3) VFDs for Injections, Sprays and Feed pumps Rs 12 Millions
4) Total Expenditures Rs.1112 Millions

Pay Back 1.14 Year

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